ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. LIII. No. 6. NEW YORK, SATURDAY, AUGUST 8, 1908. ISSUED WEEKLY

CHARLES W. PRICE . . . . . PRESIDENT AND EDITOR
STEPHEN H. GODDARD . . . . . VICE-PRESIDENT
WM. HAND BROWNE, JR. . . . . TECHNICAL EDITOR
AINSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW

CHICAGO
WESTERN OFFICE . . . . . FISHER BUILDING

BOSTON
NEW ENGLAND OFFICE . . . . . 95 MILK STREET

LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE
TELEPHONE "21 Cortland." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States	$3.00
One Year, Canada	4.00
One Year, Foreign Countries	6.00
Single Copy, 10 cents. Back numbers, beyond one month, each	.25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

Published weekly by the ELECTRICAL REVIEW PUBLISHING COMPANY, 13 Park Row, New York. Charles W. Price, president and treasurer; Stephen H. Goddard, vice-president; H. S. Tuthill, secretary.

Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.

CONTENTS

EDITORIAL:
- Electric Power in the Mine . . . 185
- The Brusio Hydroelectric Plant . . . 186
- The Value of Wood Preservation . . . 186
- Electricity in Agriculture . . . 187

Record-Breaking Telegraph Sending and Receiving . . . 188
Electrical Engineering in the Backwoods . . . 188
Regulate Stocks Now . . . 188
BOOK REVIEWS . . . 189
To Reorganize Virginia Traction Companies . . . 189
Examination for Inspector of Mechanical and Electrical Engineering . . . 189
"A.C." Accumulator Substations; and the Use of Accumulators for Peak Loads, by A. M. Taylor . . . 190
Coal-Mining Reports . . . 195
Reception to Farman by the Aero Club . . . 196
Financial Report of Electrical Companies . . . 196
Electricity in Agriculture . . . 198
The Annual Convention of the Brilliant Electric Company . . . 200
The Test-Meter Method of Testing Service Meters—I, by Joseph B. Baker . . . 201
The Extension of the Telegraph . . . 201
The Brusio Hydroelectric Plant and Its 50,000-Volt Swiss-Italian Transmission System, by Frank Koester . . . 202
Illuminating Engineering Society . . . 207
Electrical Utilities in Zanzibar . . . 207
The Testing of High-Voltage Line Insulators, by C. E. Skinner . . . 208
Illumination of a Large Office . . . 210
New Ohio Law Is Valid . . . 211
Electrical Notes from Great Britain . . . 212
Fundamental Considerations Governing the Design of Transmission-Line Structures, by D. R. Scholes . . . 213
Copper Production in 1907 . . . 215
American Electrochemical Society . . . 216
Commission Opposed to Central Express Company . . . 216
Some Interesting Advertising Literature from Central Stations . . . 217
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 218
INDUSTRIAL SECTION:
- New Gem and Tungsten Lamps . . . 220
- Sales of Small Curtis Turbines . . . 221
- New Air-Brake Type of Air-Compressor for Industrial Service . . . 221
- The Phelps Adjustable Sign . . . 222
- Motor-Driven Refrigerating Machinery . . . 222
- New Sectional-Gang Conduit Boxes . . . 223
- Glue Cookers . . . 223
- A New Seamless Trolley Pole . . . 223
- The Crocker-Wheeler Company and Ampere . . . 224
- Electrical Supplies for the Navy Department . . . 224
- The "Stavelco" Semi-Enclosed Arc Lamp . . . 224
- Wagner Transformer for United States Reclamation Service . . . 224
- New Shelby Tube Company Elects Officers . . . 224

CURRENT ELECTRICAL NEWS . . . 225
DIRECTORY OF ELECTRICAL AND ALLIED ENGINEERING AND SCIENTIFIC SOCIETIES . . . 229
RECORD OF ELECTRICAL PATENTS . . . 231

Copyright, 1908, by Electrical Review Publishing Co.

ELECTRIC POWER IN THE MINE.

In order to keep the mining industry on a par with others, the old and crude methods which employed hand labor largely have necessarily been abandoned. Here, as elsewhere, free use of mechanical power has been the means of cheapening the cost of production and increasing the output of the mines. We first saw the steam engine applied to pumping and later to hoisting, and in recent years compressed air and electricity have been adapted to driving drills and cutting machinery, while the electric motor has largely displaced the old hand-pushed or mule-drawn cars. The interest at the present time centres, therefore, not simply in the extension of the use of power in the mine, but in the kind of power most suitable for all mining purposes. We find the steam engine applied to hoisting, the use of steam-driven pumps for drainage, the application of compressed air for operating drills and other cutting machines—all of which has been done most successfully; and, what is more interesting to us, we have seen the gradual adaptation of electrical means, not merely to supplement the older methods, but actually to replace them.

The first use of electricity was, of course, for lighting, and the advantages of the incandescent system were appreciated. Then came the electric mine locomotive, which soon proved superior to the compressed-air tractor. Next the motor was applied to driving the drills and cutting machines, and here also it seems to be conquering the entire field, for when there is some old device possessing a peculiarly advantageous feature, this may almost always be incorporated in an electrically driven machine which is more easily supplied with power and transported from point to point with less difficulty.

The most recent noteworthy application of electricity in the mine has been its use for driving winding drums. Its superiority for such constant work as driving drainage pumps has long been recognized, and where electric power is available the motor-driven pump is usually selected, but for such irregular work as the driving of hoisting drums, it was thought that the older direct-connected steam engine was unquestionably the better. Even here we have seen the electric motor, when arranged to handle irregular loads economically, displace the simple engine drive and show such excellent results that the method promises rapidly to become standard practice. This last triumph of the motor leaves little work in the mine which can not be performed by some application of electrical energy. The problem of supplying power to the mine is thus greatly simplified, since all the power-generating apparatus may be concentrated in one economically operated station and the energy may be easily distributed with slight loss to any point in the mine. We have

here the ideal solution, and one which has long been looked forward to. Nevertheless, it is really surprising to note how rapidly the mines are being converted to the electric drive. An excellent idea of this is given by the mining exhibition which was held recently at London, England, at which a good deal of attention was given to the application of electric power for mining purposes. Fifteen years ago this method was not considered for anything except lighting and signaling. Now it will be but a short time before it has become the standard method in the mine.

THE BRUSIO HYDROELECTRIC PLANT.

Switzerland, a country blessed with great resources of water power, has always been a leader in the development of such sources of power. In later years, the introduction of electrical transmission of energy has added greatly to the value of the waterfalls. Thus it follows naturally that the Swiss engineers should also become leaders in this new branch of engineering. Switzerland possesses no coal mines, and hence was forced to turn to the waterfalls as a substitute for steam or gas power.

The development of electrical transmission has been particularly advantageous for Switzerland, because in that country there are many small industries as well as large. There are not only the silk mills, railways and other lines of work making large demands for power; but a system of home industries is wide-spread, and it can readily be imagined how beneficial to the whole community the distribution of power by means of electricity may be, when it is realized that frequently the demand for power does not exceed one-eighth or one-quarter of a horse-power. Much of this small power is used in the homes for making small parts of clocks, watches, etc., and it is interesting to point out that no other system of power distribution could meet these requirements. Electrical energy is, however, easily and conveniently delivered at any point, in large or small quantities, as desired, and is easily converted into mechanical power at the point required, in a small motor. This is the only method we have to-day of replacing foot-power and enabling the workman to devote his entire attention and energy to directing the operations of his machine. Such consumers are naturally widely distributed, a matter of little moment with the electrical supply company, but prohibitive to distribution of power by any other means. Nor are the large consumers of energy in that country always collected in groups. For these reasons the development of electrical transmission of energy has been a great factor in the building up of the Swiss industries.

In another field of electrical application Switzerland has also gone ahead. During recent years a number of different types of electric railway systems have been installed, including direct-current, single-phase and three-phase equipments, as well as high-potential, direct-current systems. One advantage of this tendency in Switzerland is the avoidance of smoke from factory chimneys or locomotive stacks, a feature of particular value over there where the tourists expect the air to be clear and clean, and where the least trace of smoke would bring forth criticism. And in another way electric traction systems have been of advantage in Switzerland, as they are excellently adapted to operate the many adhesion and inclined railways found throughout the mountains.

In the southern part of Switzerland, as well as in the northern part of Italy, there are many large silk and other mills, many of which formerly were driven by their own steam plants. Practically all of these to-day are supplied from large central hydroelectric stations. Italy unfortunately has few coal mines and comparatively few water powers, hence she is coming to depend upon her neighbor to the north, and draws upon the latter for electrical energy in large quantities.

In view of these conditions in Switzerland the article appearing elsewhere in this issue, in which Mr. Frank Koester describes the Brusio hydroelectric power development and its 50,000-volt Swiss-Italian transmission line, will be read with particular interest. There are a number of notable features about this plant, one of these being the high head of the water—1,300 feet. This drives direct-connected 7,000-volt, three-phase, alternating-current generators, at which potential the current is transmitted across the frontier into Italy. There it is stepped up to 50,000 volts, and transmitted eight and one-half miles to the step-down transformer stations, where it is distributed at different pressures to the various consumers.

Other interesting features of this station are the syphoning system at Lake Poschiavo; the individual switchboard for each generating unit, with its central controlling switchboard or column; the system of reinforced concrete cells for the various high-tension devices; the arrangement of the high-tension busbars, which are not, as in American practice, placed in compartments, but are only separated by reinforced concrete shelves; the complete double-line transmission system; the unique arrangement of the transformer station; and the precautionary measures adopted for protecting the plant against atmospheric disturbances, which are so frequent in this mountainous country. This transmission system may be considered the most notable one in Europe. Owing to the importance of reliability two distinct lines and two step-down transformer substations have been provided. The system as a whole may be taken as an excellent example of modern Swiss engineering.

THE VALUE OF WOOD PRESERVATION.

The electrical transmission systems and the electrical railways are among those industries which use large quantities of timber, and they are naturally feeling severely the rapid increase in the price of ties and poles, which has taken place in the past five years. It is true that both of these industries are looking for a substitute for wood, but even at the present prices there are many places where wood is cheaper than steel. As yet a satisfactory steel or concrete cross-tie does not seem to be available. Such a tie must, of course, be satisfactory in price as well as in its mechanical features. Hence it is of great importance to these industries to prevent, as far as possible, a still more rapid increase in the cost of timber. This can be done if some method of treatment is adopted which will give to the ordinary pole

a much longer life than it would have untreated, or which will make it possible to utilize woods which to-day are not satisfactory because they do not resist decay. There is nothing new in this suggestion, as it has been made many times before, and has even been actually put into practice to a limited extent; but it is evident that the true value of such treatment is not yet fully realized, otherwise it would be much more frequently resorted to. In the current issue of the *Engineering Magazine* this feature of the problem is considered by Mr. C. P. Winslow. His discussion is not limited to the value of this process for the electrical industry alone, for he takes the matter up in a broader way. He does, however, point out how the cost of timber may be reduced by a proper treatment, and makes particular reference to the effect that this would have upon the tie problem and the cost of poles for transmission and distribution purposes.

The application of any preservative treatment can not, of course, reduce the cost of the piece of timber, except by making it permissible to employ a cheaper grade of stock. But even in this event it is likely that the cost of the treated piece would be nearly, if not quite, as great as that of an untreated piece of better material; but when one takes into consideration the increased life which the treatment gives, thus saving the first cost of a new piece, at an increased price and the cost of putting it in place, the value of the treatment is evident.

There is also a broader aspect which recently received considerable attention, and that is the preservation of our forests, so that they may supply the needs of future generations, and the avoidance of further destruction of our water powers. Unless the consumption of timber can be reduced we will soon be at the end of our supply, and there can be little doubt that the preservation of timber from decay will become one of the important means of decreasing the drain on our supplies.

As an illustration of the economy of preservative treatment one or two of Mr. Winslow's figures may be quoted, and it should be understood that his contention is not that such a treatment may become profitable in the future, but that the treatment is profitable to-day, since at the slight increase in the cost of the material, the annual charge for ties or poles, as the case may be, is reduced. For example: A thirty-five-foot pole for an electric line, of either loblolly or old-field pine, may be had for about $5 at its origin of growth; such a pole if not treated in any way will last about five years; hence allowing interest at five per cent the annual charge will be $1.15. Treating the butt of the pole with creosote will give it a life of about twenty years, at an increased cost of only about one dollar, so that the annual charge is reduced to forty-eight cents; and, of course, the further from the source of supply the higher the price of the pole and the more profitable will the treatment be. In the same way Mr. Winslow shows that the annual charge for a railway tie may be reduced from 16.8 cents to 10.7 cents by a proper treatment. The untreated tie is assumed to cost seventy-five cents, and to last five years; the treated tie is assumed to last ten years. But even should it last only six years it would still show an annual saving of two-tenths of a cent.

This phase of the problem, the actual saving in the yearly cost of maintenance, is one which will appeal to the constructing and operating engineer, and should lead to a much wider use of preservative treatment than is at present made. One difficulty to-day is the comparatively few places where such treatment may be given; but this is a lack which should be quickly supplied. The preservative treatment has been used in Europe for years past, and its value has been unquestioned, and there is little reason for holding off any longer against it in this country.

ELECTRICITY IN AGRICULTURE.

On another page of this issue we publish a statement by Sir Oliver Lodge of the results which have so far been obtained from the experimental application of electrical stimulation to growing plants. We have already referred to these experiments, which were first made at Bitton, near Bristol, England, and then on a larger scale at Gloucester. There is no information of the results of these latest tests, as, of course, the effect of this year's experiments has not yet been determined.

As we have pointed out before the apparent effect of electrical stimulation is so great, and the energy required so trifling, that practically the only cost of applying this treatment is that of installing the system. This should be very small compared with the increased value of the crops. In several cases an increased yield of thirty to forty per cent was obtained, while the grain from the electrically treated plot was said to be better and brought a better price than that from the untreated neighboring plot. In some cases where an increase in the weight of the harvest was not found there was an increase in its value. This was the case with beets, which contained several per cent more sugar than did those from the control plot. The experiments were repeated again this year, and a little later we will probably have some new facts which may throw additional light on the problem.

It is much to be desired that similar tests be conducted elsewhere, on a scale at least as large as that in England, where altogether about twenty acres are used in the experiments. It would be well also to have tests conducted in as many different parts of the world as possible, because the value of the treatment might be much greater in northern latitudes, for example, where there is less sunlight, than nearer the tropics. In some climates and on certain soils it might have little or no value; indeed it might, perhaps, be detrimental. It might even be found that an electrical treatment would take the place of fertilizers, as some agriculturalists contend that the chief value of the manures is to render the plant food contained in the soil more available. The vigorous growth produced by electrical stimulation may possibly enable the plant to secure its food without other assistance. It is true that we now have one or two methods of preparing artificial fertilizers from atmospheric nitrogen, and if these live up to their present promises, the fertilizer situation may be somewhat relieved, if not saved; but these fertilizers are necessarily expensive, and the cost of using them would be much more than that of electrical stimulation. The problem as presented is interesting, and well worthy of careful study and investigation.

Record-Breaking Telegraph Sending and Receiving.

During the recent Democratic National Convention at Denver, the chief telegraph operator of the New York *Sun*, George W. Conkling, performed a feat in telegraph sending which is unparalleled for speed, accuracy and endurance, even in this branch of engineering where heroic work is by no means the exception.

Working over a wire that stretched more than half way across the continent, about 2,500 miles, Mr. Conkling attained the high speed of 3,136.20 words an hour, or 52.27 words to the minute, a record which has never before been equaled anywhere.

Furthermore, Mr. Conkling in just twenty-eight working hours sent over this wire to his paper by the Morse system and using the Phillips code a total of 73,000 words, an average of 2,607.14 an hour, or 43.45 words a minute.

Much of this matter was sent from a seat in front of the speakers' stand in the convention hall while pandemonium was being raised.

The wire worked by Mr. Conkling was a duplex circuit. It really was four wires joined together by the Western Union company for this emergency. It ran from Denver to Kansas City, thence to St. Louis, thence to Pittsburg and thence to New York.

It is impossible to transmit over such a distance without the aid of repeaters, or automatic relays. These were at Kansas City, St. Louis and Pittsburg.

At each of these men were stationed at the direction of Mr. Conkling to "refine" the wire, as the operators say. Their duty was to keep readjusting the repeaters and make sure that the circuit was just right in spite of weather conditions and other things.

To send an average of 2,600 words an hour it is absolutely necessary that every letter should be distinct, otherwise the man receiving will have to break in and have it repeated. The man at the receiving end of the wire from Denver, H. R. Clark, did not break in on Mr. Conkling once in three hours, a record in itself.

In the long session of Thursday night, at which Mr. Bryan was nominated at 3.45 A. M., Denver time, words were flashed from Denver right into the New York office at the rate of fifty-two a minute and were taken by Mr. Clark on a typewriter without a break, the ticks of the instrument in the office being as distinct as if the wire ran to Harlem instead of to the Rockies. Besides being a record for speed it was also one for endurance.

On July 7, the first day of the convention, Mr. Conkling sent 14,750 words in five hours and twenty-three minutes, an average of 2,789 words an hour. On July 8 he increased the average to 2,949 words an hour, sending 8,100 words in two hours and forty-five minutes, and on the day following the record was 5,750 words in one hour and fifty minutes, or 3,136 words an hour.

The last day of the convention Mr. Conkling sent 10,370 words in three hours and twenty minutes, or 3,111 words in an hour, which was only a shade under his record of the previous day.

Not only is this put down as a record as long-distance work goes, but there is nothing in the archives to show that it has ever been done over short lines.

Mr. Conkling, in 1903, won a silver loving cup as the most perfect sender with a Morse key.

Mr. Clark, some years ago, received and wrote on a typewriter a president's message containing 22,000 words in ten hours without misplacing a single letter or "breaking in" on the sending operator.

Electrical Engineering in the Backwoods.

To the Editor of the Electrical Review:

"We were sitting around the stove in the bar of a little hotel in a Maine town," said an electrical salesman, "when the electric lights flickered and went out.

"From the darkness came a solemn voice that said:

" 'Electric lights all out, b'gosh, and yet it ain't blowin' hard either. Something's happened to the dynamo, maybe.'

"I had been selling electrical supplies to the little lighting companies for several months but I had never heard this particular idea expressed before.

"I laughed long and loud, and was all the more amused when no one joined me.

"After they had lighted a big kerosene lamp, I proceeded to explain to the crowd that incandescent lamps can't be blown out by the wind. When I had finished, the old rube who had commented on the lights said:

" 'Look here, young man, if you knew a little somethin' about local conditions and about your own business, you'd know that the wires in this township are hung up slack on the poles in some places and that they get to slatting in a good stiff breeze. When they do, there's a short-circuit that puts the line out of business.' "

R. G.

Regulate Stocks Now.

To the Editor of the Electrical Review:

The men who have their fingers on the pulse of our commercial life, and whose statistics measure the beats of the great arteries of business, are advising us that conditions are improving; the pulse is quickening, and a normal tone is becoming more of a surety.

This is as it should be. We have had time to adjust business to a great degree to the conditions brought upon us by the calamities of a few months ago. Manufacturers have curtailed their orders for raw material, and also their output, and have used up surplus stocks they had on hand. Wholesalers and jobbers have likewise reduced their stocks to the minimum, and so down the line from mine to finished product, from raw material to consumer, the closest scrutiny has been exercised to prevent congestion and loss.

Manufacturers, dealers and consumers of electrical machinery and supplies were among the first to be affected by the tidal wave of disaster, and they have made strenuous efforts to adjust themselves to the new conditions imposed.

Now that a more healthy tone is evident, it is the part of wisdom for the electrical manufacturer and dealer to foresee the conditions and meet them as they appear. Unless this is done, there will be greater difficulty than has been heretofore experienced in meeting the demands of consumers.

We have climbed the hill of prosperity and know how inadequate has been the ability of our jobbers, wholesalers and manufacturers to supply promptly the contractor, the central station and the public with the material they required; and when such material was obtainable, such was the congestion on the lines of transportation that long delays were the rule.

Now is the time when every dealer of apparatus and supplies should look over his stock and figure his probable requirements; and then order all he can safely handle. This will assist the manufacturer in his estimates of what he is likely to require in the matter of raw material and skilled labor in order to produce the finished product. Every item that can be safely ordered now will assist just that much in overcoming the difficulties that are sure to come on us both in production and transportation if orders are held up until material must be used. Prices now are right, and advantage should be taken of them and of the general conditions. To do this is to "take time by the forelock."

J. E. Perego.

Chicago, Ill., August 1.

BOOK REVIEWS.

"How to Become a Competent Motorman." V. B. Livermore and J. R. Williams. New York. D. Van Nostrand Company. Cloth. 248 pages. Illustrated. 5 by 6½ inches. Furnished by the ELECTRICAL REVIEW for $1.

The authors of this book have endeavored to prepare a guide for the motorman which, without confusing his mind with undigested scientific principles, will explain to him the use of the different devices which go to make up the equipment of the modern electric vehicle. The different types of controllers are described and the effect of each movement of the controller handle is explained. Wiring diagrams are given for these systems. The troubles likely to happen to the different parts of the equipment are explained, the symptoms of each being pointed out and advice suitable for each emergency is given. The concluding portion of the hand-book deals with the different air-brake systems and tells how they should be taken care of. There is also a short chapter dealing with signals and signaling.

"Dynamo-electric Machinery." Francis B. Crocker. Chicago. American School of Correspondence. Cloth. 236 pages. Illustrated. 6½ by 9½ inches. Furnished by the ELECTRICAL REVIEW for $1.50.

This is one of the series of practical working guides which is being brought out by the American School of Correspondence. The object of the book is to give a simple and at the same time authoritative discussion of the theory, construction and design of dynamo-electric machinery. The general arrangement of the subject is that usually found in such books. The elementary theory of electromagnetic induction is first explained and it is shown how this is applied in the production of the electromotive force in the dynamo. The reactions produced by the load on the dynamo are then explained and the means adopted to minimize them are described. Part two deals with the characteristics of dynamos of different types and shows how these may be predetermined. The calculation of the magnetic circuit is taken up, followed by a discussion of methods of winding and some useful hints for the mechanical design are given. Part three deals with the construction of continuous-current machines and describes in some detail the different types of designs which have been found successful. In this section some tables of dimensions and speeds, which should be useful to designers, are given. The problem of treating in a satisfactory way the whole subject of continuous-current machines without writing a large book is not easy, but Professor Crocker has solved it here very successfully, his plan being to dwell upon the essential features, and pass over those not so important.

"Telephone Law." A. H. McMillan. New York. McGraw Publishing Company. Cloth. 332 pages. 6 by 8½ inches. Furnished by the ELECTRICAL REVIEW for $3.

The object the author of this book had in mind was to place in compact and concise form such legal information as would be of value to the practical telephone man. The book was not intended for practising lawyers. For this reason it is not exhaustive. A good deal of matter presented is of local interest, as must necessarily be the case where there are so many state governments; and it is, of course, impossible to cover every phase of this complex subject. However, what is here given will be of considerable assistance to the telephone man.

"Notes on Hydroelectric Developments." Preston Player. New York. McGraw Publishing Company. Cloth. 68 pages. 3 diagrams. 5 by 7½ inches. Furnished by the ELECTRICAL REVIEW for $1.

This little treatise has been prepared to assist investors in reaching a reliable understanding of the possibilities of any proposed hydroelectric development. The author purposely avoids discussing the engineering features of such developments, and refers to them only so far as is necessary to give a clear understanding of the power that can be obtained at any site and of the possible means of producing it. In Chapter i he gives a list of matters which should first be looked into. These include the general physical conditions of the site, records of past floods, and the possible markets for power. In Chapter ii a method of procedure for obtaining this information is suggested. In Chapter iii he explains the kind of engineering examination that should be made. In Chapter iv the market for power is considered, with the possible competitors of the power plant. Chapters v and vi deal with the cost of producing energy, and central station economics; Chapter viii with the sale of energy; Chapter ix takes up the problem of producing secondary power, and the concluding chapter of the book deals with the effect of capital cost upon the selling price of energy. The book seems to be admirably adapted to its purpose, as a technical education is not necessary to follow the argument. It should enable any business man to reach a satisfactory conclusion respecting the value of any power site, provided, of course, he follows the plan here laid out.

To Reorganize Virginia Traction Companies.

The reorganization of the Virginia Passenger and Power Company, the Richmond Passenger and Power Company, the Richmond Traction Company and controlled lines has been undertaken by a committee consisting of Douglas Robinson, of New York, chairman; Frank J. Gould, of New York; Charles S. Whelan, of New York; Percy M. Chandler, Philadelphia; R. Lancaster Williams, of Baltimore, and Fritz Sitterding, of Richmond, Va., with John D. Dickinson, Jr., secretary, and Henry W. Anderson, counsel, and Carter, Ledyard & Milburn, consulting counsel.

The committee has prepared a plan of reorganization which has been deposited with the Bowling Green Trust Company as depositary and requests the holders of the various securities affected by the reorganization to obtain the same and deposit their securities under it before September 3. The protective committee of the Richmond Passenger and Power Company consolidated bondholders and a similar protective committee representing the South Side Railway and Development Company's bondholders have endorsed the plan of reorganization.

Examination for Inspector of Mechanical and Electrical Engineering.

The United States Civil Service Commission announces an examination on September 2 and 3 to secure eligibles from which to make certification to fill a vacancy in the position of inspector of mechanical and electrical engineering, at $2,190 per annum, in the office of the supervising architect, Treasury Department, and vacancies as they may occur in any branch of the service requiring similar qualifications. The duties of the specific position consist of inspecting and testing mechanical and electrical equipment entering into the modern government or office building, requiring high-class education and extensive experience in all branches of enginering embracing this class of work. Applicants should apply at once to the United States Civil Service Commission, Washington, D. C., for application form 1,312. No application will be accepted unless filed with the commission in complete form prior to the hour of closing business on Saturday, August 22. In applying for this examination the exact title as given in the heading of this announcement should be used.

"A.C." ACCUMULATOR SUBSTATIONS; AND THE USE OF ACCUMULATORS FOR PEAK LOADS.[1]

BY A. M. TAYLOR.

Many causes have conspired to delay the introduction of accumulators into central stations in this country for the purpose of supplying energy for light and power during the time of peak load.

The non-fulfilment of the great expectations raised some twenty years ago has had its reaction, and numerous failures in actual practice have caused central station engineers to lose confidence in all cells of every make for light and power supply as a substitute for generating plant.

Even when one succeeds in convincing an engineer that a battery will pay for itself if it only lasts as short a period as, say, five years, and that, therefore, there can not be much risk in installing it (as guarantees for much longer periods of maintenance can be had, at reasonable rates, and from responsible parties), the said engineer will hesitate to put it in directly it is brought home to him that, in order to insure its paying under these conditions, it must be relied on as a real, and not merely a nominal, substitute for generating plant.

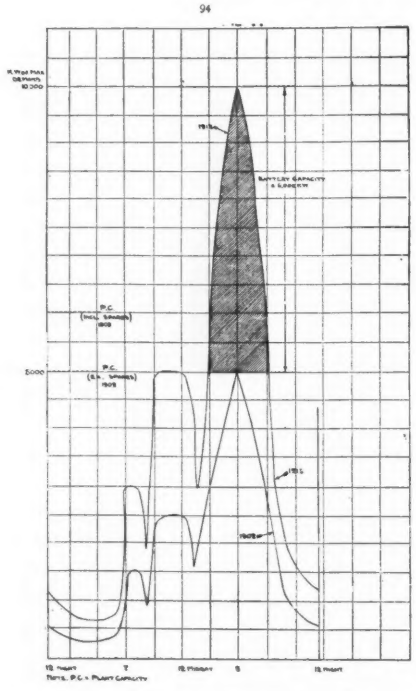


FIG. 1.—TYPICAL LOAD CURVE FOR STATION HAVING PRESENT MAXIMUM DEMAND OF 5,000 KILOWATTS. FURTHER EXTENSIONS ARE ASSUMED TO BE CARRIED OUT WITH BATTERIES.

[1] Abstract of a paper read before the Incorporated Municipal Electrical Association, Nottingham (England), June 30 to July 3

ENERGY LOSSES.

It requires to be realized by engineers that, if cells are installed exclusively to take the peak of the load, and are not discharged unnecessarily, the value of the energy wasted in the cells and accessories is only of the order of one to two per cent of the value of the revenue introduced by said cells. Consequently their inefficiency is not nearly so serious a matter as most people imagine.

Consider Fig. 1, the lower half of which shows a typical load-curve for a station having a present maximum demand of 5,000 kilowatts. All further extensions are assumed to be carried out with batteries until, in 1913, the maximum demand reaches 10,000 kilowatts.

Neglecting changes in the load-factor, we may assume that, say, 5,000,000 units are sent out in 1908, and 10,000,000 units in 1913. The battery has thus introduced a revenue of, say, $156,000 per annum (taking three cents as an all-round price for light and power and neglecting losses in transmission in each case). What are the losses due to the inefficiency of the battery and adjuncts?

The lower curve in Fig. 2 has been compiled from figures published for the maximum demands at Neptune Bank by Merz and McLellan in April, 1904, as a rough approximation to the relative periods of time which the station was working during the year on different loads.

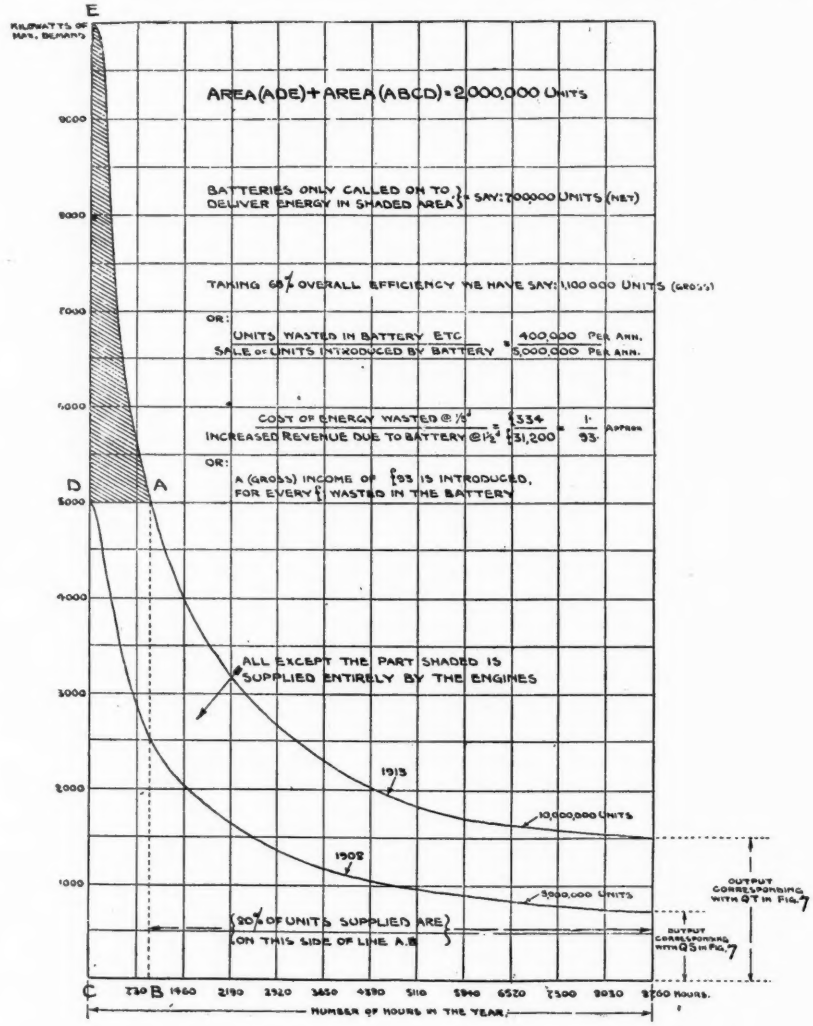

E
AREA (ADE) + AREA (ABCD) = 2,000,000 UNITS
BATTERIES ONLY CALLED ON TO DELIVER ENERGY IN SHADED AREA } = SAY: 700,000 UNITS (NET)
TAKING 60% OVERALL EFFICIENCY WE HAVE SAY: 1,100,000 UNITS (GROSS)
OR:
UNITS WASTED IN BATTERY ETC / SALE OF UNITS INTRODUCED BY BATTERY = 400,000 PER ANN. / 5,000,000 PER ANN.
COST OF ENERGY WASTED @ 1/8 / INCREASED REVENUE DUE TO BATTERY @ 1 1/2 = £334 / £31,200 = 1/93 APPROX
OR:
A (GROSS) INCOME OF £93 IS INTRODUCED, FOR EVERY £1 WASTED IN THE BATTERY
D
A
ALL EXCEPT THE PART SHADED IS SUPPLIED ENTIRELY BY THE ENGINES
1913
10,000,000 UNITS
1908
5,000,000 UNITS
(20% OF UNITS SUPPLIED ARE ON THIS SIDE OF LINE A B)
OUTPUT CORRESPONDING WITH QT IN FIG. 7
OUTPUT CORRESPONDING WITH QS IN FIG. 7
C
730 B 1960 2190 2920 3650 4380 5110 5840 6570 7300 8030 8760 HOURS.
NUMBER OF HOURS IN THE YEAR.

FIG. 2.—ANALYSIS OF PROPORTION OF WORK CARRIED BY ENGINE AND BATTERIES.

Referring to the upper curve of Fig. 2, which embraces the extra 5,000,000 units "introduced" by the battery, it will be noticed that the batteries are only called upon to deliver energy when the peak exceeds 5,000 kilowatts. They are, of course, charged when the load is small and the engines and boilers inefficiently loaded.

To simplify the question, the author, in the notes accompanying Fig. 2, has

only considered the employment of the battery in the winter, and for discharging at the heaviest peaks; the extra losses involved in the occasional charges and discharges required during the summer are not serious.

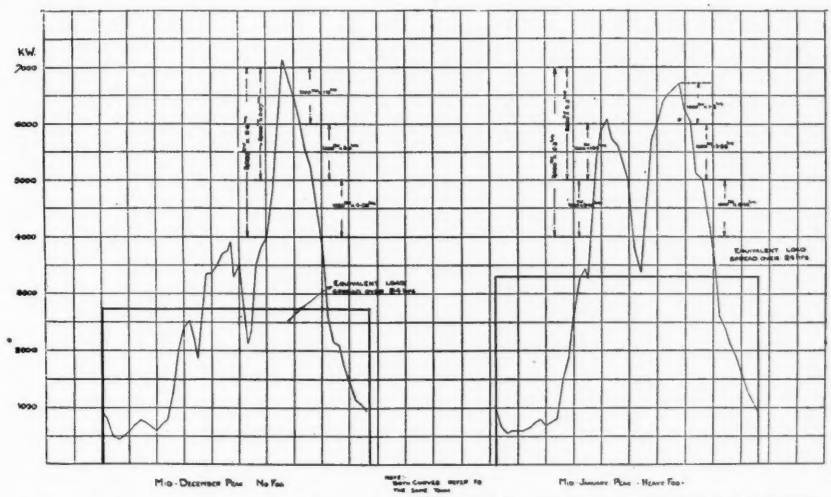


FIG. 3.—TYPICAL STATION LOAD CURVES, SHOWING DURATION AND EXTENT OF BATTERY DISCHARGE.

Referring to the notes accompanying Fig. 2, it will be noticed that some 1,100,000 units are put into the battery; of which some 700,000 are reclaimed as "useful" work. In the figures for the increment in fixed charges due to the introduction of the battery (considered later in discussing Fig. 6), the author debits the "extra" units introduced by the battery with the whole of the increment in the fixed charges of the station, as well as with the capital charges on account of the cells; consequently it is unnecessary to debit the 400,000 "wasted" units with anything beyond the coal, water and petty stores consumed. These items are sufficiently covered by the two-fifths cent allowed. The cost of 400,000 units at two-fifths cent (or $1,600) is, then, the sum which we must set off against the revenue of $156,000, introduced by the cells, on account of the "wasted" units in the battery.

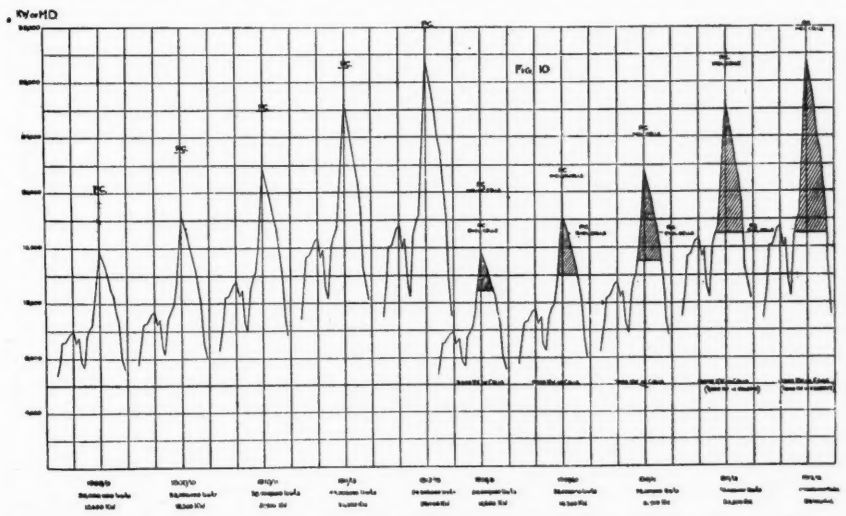


FIG. 4.—ASSUMED ANNUAL DEVELOPMENT OF STATION PEAK LOAD COMPARED WITH SAME DEVELOPMENT ASSISTED BY STORAGE-BATTERY INSTALLATION.

PROPORTION OF PEAK TAKEN UP.

The capital cost of the cells depends, of course, very largely on the proportion of the peak which is taken up by them, each successive kilowatt so taken up requiring a longer period of discharge. This will be evident from Fig. 3, the left-hand diagram of which shows the peak load of a station in a large industrial town, and may be taken as a typical case. Referring to this figure it will be noticed that the first thousand kilowatts taken up require only an average duration of discharge of 1.15 hours, the second thousand kilowatts require three hours, and the third thousand kilowatts 4.26 hours. The average duration of discharge for 3,000 kilowatts taken up is as shown, 2.8 hours, and for 2,000 kilowatts it is 2.07 hours.

On the right-hand side of Fig. 3 is given a peak load-curve for the same station during an exceedingly heavy fog, and the corresponding hours of duration for each successive thousand kilowatts on either of the two humps of this peak are given in horizontal figures, the equivalent hours of duration for the joint load of the two peaks being given in vertical figures; the notes at the top of the figure show the capital cost, per kilowatt of maximum demand taken up by the cells, for different proportions of the peak, both for the left-hand and for the right-hand diagrams. It will be noted that the cost for taking up $\frac{2000}{1000}$ of the peak in the right-hand diagram is very little in excess of that of taking up $\frac{3000}{1000}$ of the peak in the left-hand diagram.

In the comparison which will now be made between the cost of generating plant and batteries, it is assumed that no provision is made for dealing with fog loads, there being numerous towns in the country where such loads are not materially felt. Even where the contrary is the case, the battery can still hold its own, provided that a lesser proportion of the peak is taken up.

CELLS *v.* GENERATING PLANT.

In order to obtain a clear idea of the various economies, both in capital cost and running expenses, which may be effected by the introduction of cells to take the peak of the load for light and power work, a typical station has been selected, in which the annual development is assumed to progress at a healthy rate, and the effect is noted of installing accumulators to deal with the peak of the load in place of generating plant, and the annual expenses are estimated in the two cases over a number of years.

On the left-hand side of Fig. 4 is shown the assumed annual development of the peak of the load for a large steam-power station, and the plant capacity allowed (including spares) to meet same.

On the right-hand side of Fig. 4 is similarly shown the same station carried over the same term of years by means of cells added to the existing generating plant, no further generating plant being put down. In both cases only sufficient spare plant has been allowed to cover the chance of a breakdown of one of the generating units. This may be criticized as insufficient, but owing to the large capacity of the battery for short-period discharges, the comparison would undoubtedly show still more favorably to the latter

if a larger margin of spare-plant capacity were allowed. In Fig. 5 is given the estimated figures for the development of a steam station whose demands are shown by Fig. 4, no battery being considered, and in Fig. 6, the corresponding expenses, with the accumulators considered in Fig. 4 are similarly expressed. It will be noted in the latter figure (6) that the steam expenses incurred in the year 1907-8 are taken as the basis, and it is assumed that since no further generating plant is added, the fixed charges, and interest and sinking fund charges, will remain constant.

To the total of the steam-plant charges incurred in the year 1907-8 is added a sum representing twelve per cent on the cost of the cells added during the year 1908, and the total so obtained is plotted as the cost for the year ending in March, 1909. The capital cost of the cells and their accessories inclusive of building has been put in at £15 ($75) per kilowatt throughout. In the years 1910 to 1911, 1911 to 1912 and 1912 to 1913, a small sum (£1,000) has been added to cover the cost of extra wages for attending to the cells and apparatus.

With reference to the twelve per cent taken on the cost of the cells in the above figures, it may be explained that interest charges on the cells are taken at three per cent and depreciation and maintenance charges at nine per cent.

It will be noted that in Fig. 6 the savings introduced by the cells, as against steam plant, are £12,000 ($60,000), £24,000 ($120,000), £37,000 ($185,000), £46,000 ($230,000) and £64,000 ($320,000), respectively, in the five years following 1907-8; a total saving of £183,000 ($915,000).

Taking the increments which each year show over 1907-8 in annual expense, and dividing these by the corresponding increments in units sold, shows that for the steam plant the costs of each extra unit sold are 2.18 cents, 1.8 cents, 1.82 cents, 1.72 cents and 1.70 cents, whereas with the combined steam and accumulator plant the corresponding costs are found to be 1.24 cents, 0.88 cent, 0.8 cent, 0.84 cent and 0.78 cent, with the result as already stated that the total net saving in five years is $915,000 after providing for the payment of interest, depreciation and maintenance on the accumulators, representing an average saving of $183,000 per annum.

It may be pointed out that the £64,000 ($320,000) saving in 1912-13, would pay an additional ten and one-half per cent interest on the total investment in cells and accessories, including that of 1912-13.

As a further illustration of the relative costs of the cells and of the steam plant, the author has resolved the cost into curves, connecting load-factor and price per unit, which are shown in Fig. 7. In this figure the cost for the battery itself and the increment in fixed charges introduced by it is shown by the curve AB, the corresponding curve for the increment in the generating plant (excluding distribution) being marked CD on the above figure. It is to be noted that in these two curves (Fig. 7), we have a comparison between the cost of introducing to an already large generating station the necessary steam plant, of the most modern reciprocating type and in large units, in order to deal with a stated increment in the maximum demand of the station; and on the other hand, the corresponding costs for accumulator plant capable of dealing with the same increment in the maximum demand. We are not, therefore, comparing merely the total capital and other costs per kilowatt, incurred to date (which figure would be handicapped by the amount of capital that had been spent in past years on obsolete or inefficient plant), but are considering the relative merits of the two systems under absolutely identical conditions. To show the difference that would be obtained in favor of the electric accumulator system, were we to compare its added costs with the existing costs of the steam system (as we might do if the station had reached its limit of exten-

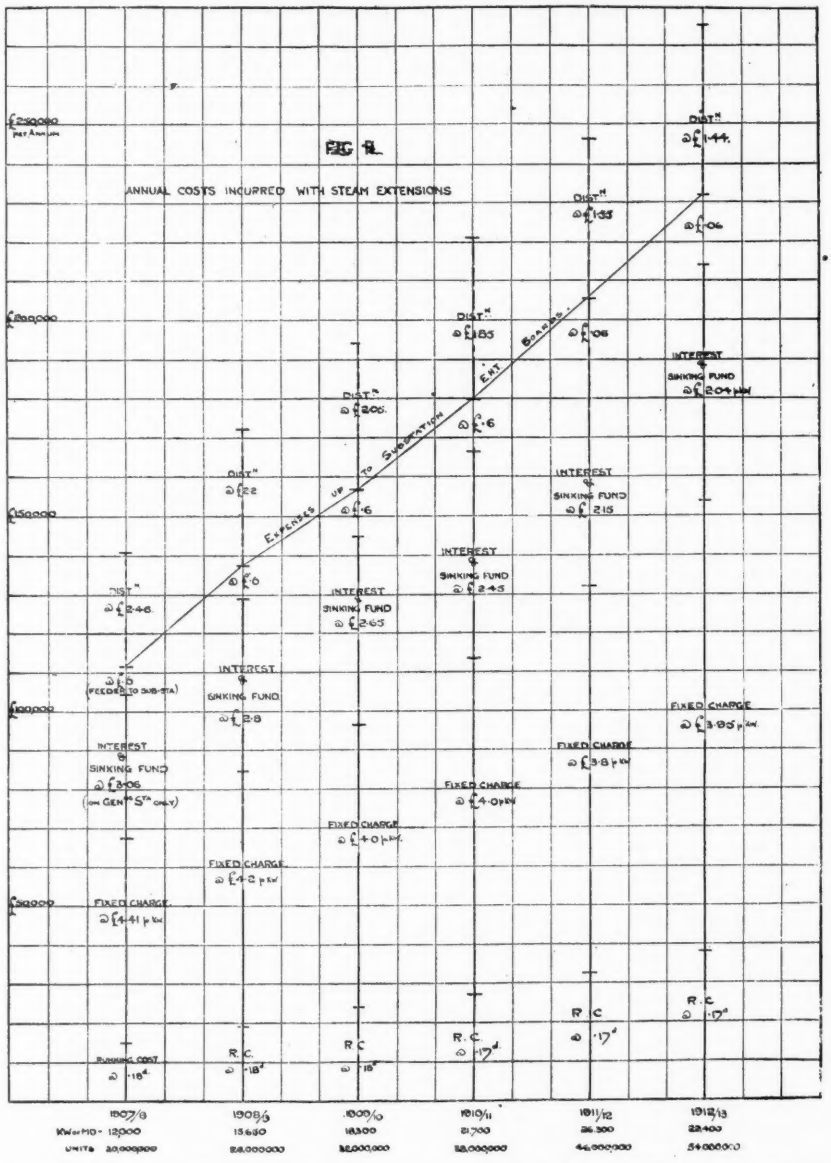


FIG. 5.—ESTIMATED FIGURES FOR DEVELOPMENT OF STEAM STATION, NO BATTERY BEING CONSIDERED.

sion), we have only to compare curve AB with curve EF (the latter representing the costs for 1907-8, for any load-factor, as deduced from the ordinate plotted for a particular load-factor in Fig. 5). The author submits that in estimating the saving introduced by putting down accumulators, it is not in certain cases unfair to take the difference in costs between the curves EF and AB as representing the saving, since the station is at the present time charging the consumer on the basis of the curve EF, while the added cost for each unit sold with the accumulators is only that represented by the curve AB.

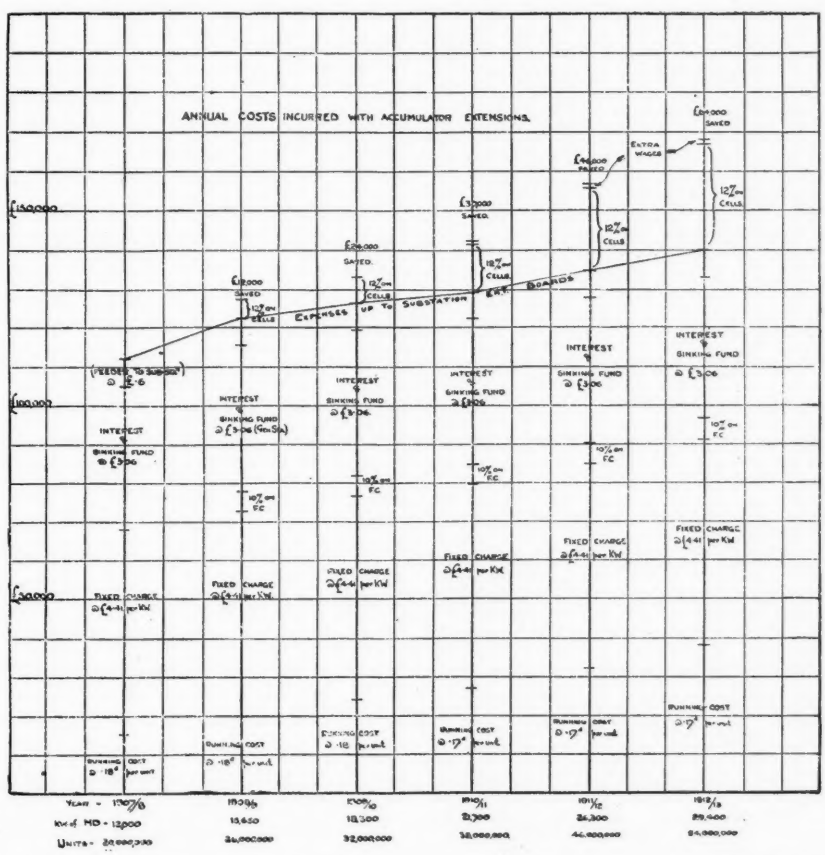


FIG. 6.—ESTIMATED FIGURES FOR DEVELOPMENT OF STEAM STATION, WITH STORAGE BATTERY CONSIDERED.

Each extra unit sold (due to the growth of the load) would therefore bring in, if present prices remained unaltered, a net profit represented by the difference between these two curves; or say 1.9 cents per unit on a sixteen per cent load-factor.

ALTERNATING-CURRENT SUBSTATIONS.

The author trusts that, in the examination of the energy losses incurred by the accumulator system it will be conceded that the cost of the energy used in charging the cells is so very low that the inefficiency of the cells and accessories is much more than compensated by the gain in coal economy on the "interest-paying" units. The result of calculations which he has made in conjunction with the employment of substations has satisfied him that there is a future for such a scheme, (particularly in connection with long-distance transmission of power), the batteries being put down here, rather than at the generating station.

The limits of the present paper do not allow of going into details but, from inquiries made of accumulator companies, it is found that, where cells of very large individual capacity can be installed, it is possible to obtain a discharge representing six kilowatts (on a three-hour basis) for every square yard of floor space, for a single tier of batteries; and where there are two tiers this would be raised to twelve kilowatts, or if three tiers, eighteen kilowatts per square yard of ground space. These figures do not include any space for the rotary converters, or the boosters or auxiliary apparatus; but where the units are of moderate size, the extra floor space required for these is not at all serious. Assuming for the moment that a separate building were erected for the cells, of a cheap construction, it would be quite possible to erect such a building, where the cells were on a single floor only, for something under $1.87 per kilowatt, and even where the cells were arranged on two floors, or even three floors, the cost of such a building need not exceed, say, $3.75 to $5 per kilowatt, and, of course, the cost of maintenance of such a building is trifling compared with that of the cells.

As regards the cost of land, this, in the vicinity of substations, could, generally speaking, be obtained at a rate not materially in excess of $3 per square yard, which, for a single-story battery, works out at fifty cents per kilowatt, which is really quite negligible compared with the cost of the battery. It is, however, of course, often a matter of the greatest difficulty to get the land just where it is required, and hence it is highly desirable to adopt any means whereby the floor space required for the accumulators can be greatly reduced. In the smaller sizes of substations, such as would be employed for prospecting purposes, and in fact up to 2,000 kilowatts, the author believes that his low-voltage system of accumulators will be found very useful in reducing floor space (as well as capital cost), and he has taken advantage of the facilities which the employment of alternating currents offers for stepping down the voltage to produce a scheme which is at once cheap, flexible and easily extensible with the growth of the load in the substation. By this means it is possible to use the batteries to deliver alternating current of high pressure into the line at times of peak load, while at the same time delivering direct current of suitable pressure to the bus-bars of the substation, and the author believes that this and other combinations will be found to be valuable as a means of relieving the main generating station at the time of peak load, as well as the feeders. The efficiency to be obtained on discharge, as between battery terminals and extra high-tension alternating-current bus-bars, will, in a large substation, be found to be of the order of ninety-three per cent, and that between the battery and the substation direct-current bus-bars of the order of eighty-seven per cent, and even in a small substation these figures would not be materially less than ninety per cent and eighty-two per cent, respectively. It is further suggested that such a system may be found very helpful on long high-pressure lines, such as those on the outskirts of a power company, the accumulator in this case enabling a given amount of maximum demand to be met at a subcentre for a very much less expenditure in extra high-tension cables than would otherwise

be incurred; or, to put it in another form, it would be possible to supply a given maximum demand at much greater distances from the main generating station with economy than has hitherto been the case. Indeed, if the savings introduced in the generating plant by the adoption, in this way, of accumulators at the substations were utilized for the purpose of extending the lengths of the extra high-tension feeders, it might be possible to carry the transmission several times as far as is now considered practicable, without incurring any greater charges than would be incurred by the continuance of the use of steam plant for extensions, coupled with the employment of the shorter feeders.

with ample station and street accommodation for extensions in all feeders to substations, and on the further assumption that there is land adjoining the station to accommodate additional steam plant. Where any, or all, of these facilities do not exist, especially if the limit of the station development has been reached, there is a strong case for accumulators.

By their means it is quite possible to postpone the erection of a new station for some years and thus to obtain the advantage of the latest and best experience in the selection and performance of plant.

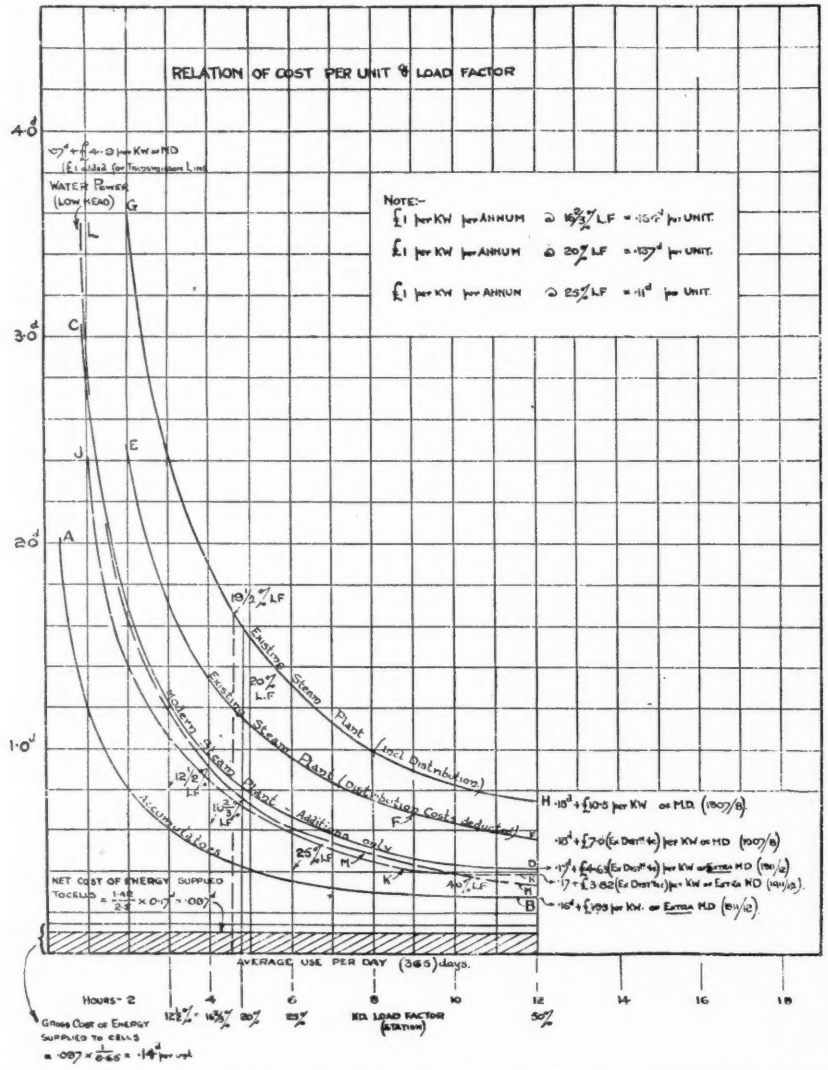

RELATION OF COST PER UNIT & LOAD FACTOR
WATER POWER (LOW HEAD)
NOTE:-
Existing Steam Plant (incl Distribution)
Modern Steam Plant - Additions only
Existing Steam Plant (Distribution Costs deducted)
Accumulators
NET COST OF ENERGY SUPPLIED TO CELLS
AVERAGE USE PER DAY (365) days.
HOURS- 2
LOAD FACTOR (STATION)
Gross Cost of Energy supplied to Cells

FIG. 7.—NET EFFECT OF USING CELLS ON THE COST OF EXTRA UNITS AND STATION LOAD FACTOR.

CONCLUSIONS.

In the present paper the author's investigations have been confined to the consideration of the introduction of cells in connection with a large modern station,

As regards the introduction of accumulators into the smaller stations, the author ventures to express the opinion that the causes of high coal consumption in these stations are due, not altogether to the smallness of the engine and boiler units, or even to their being of somewhat obsolete type, but rather to the greater proportion which the stand-by losses and the fixed charges bear to the total cost of operation. The use of cells would introduce great economies here; and in many cases would enable the existing small units to be replaced by large and more economical units with the certainty of being able to find a suitable load for the latter, even where the load-factor of the station happens to be a poor one; thus avoiding, in many cases, the immediate building of a new station.

The author suggests that Fig. 7 will be found helpful as showing at a glance and in a single diagram the net effects of using cells on the cost per (extra) unit for different (station) load-factors. It also shows in a clear way the pronounced saving introduced by using cells, as against modern steam plant; and that, too, of the largest sizes likely to be available in the majority of cases.

The capital costs taken for the increment of steam plant (including building and land) range from $200 to $100 per kilowatt of plant capacity added. It may here be mentioned that in the costs plotted in Fig. 5 the cost of the feeders on the extensions to the substation where the battery is placed is also debited to the steam extensions, an allowance of $3 per kilowatt of maximum demand per annum being taken. In Fig. 7, however, this is reduced to $1.50 per kilowatt of maximum demand.

The figure of $75 per kilowatt of maximum demand for the batteries similarly includes building and land, but no spare battery capacity; there being 100 per cent overload capacity in the battery for one hour, and the chance of interruption with a properly designed battery plant being so much more remote than with running machinery, or even steam boilers and accessories.

As regards the transmission of power over long distances, such as from water-power centres, the author suggests that the facilities for increasing the radius of transmission (for a given limitation in electromotive force) which the storage system offers, combined with the great advantage of having the reserve of power at the point where it is wanted, should be considerations of moment in introducing cells for such work. There are many large water-power transmissions on which he believes it will be found that the curves connecting load-factor and cost per unit will consist of a much smaller element of "running cost" and an equally large, or larger, element of "fixed charges" than in the steam station shown in Fig. 7 (especially when transmission line costs are included), and on all such there should be an excellent opening for alternating-current substations.

Coal-Mining Reports.

According to the figures prepared by the United States Geological Survey, in 1907 Ohio produced 32,142,419 short tons of coal, having a spot value of $35,324,746. Early in 1908 George Harrison, chief inspector of mines for Ohio, estimated that the total production of the state in 1907 had been about 30,000,000 tons, which would have been equivalent to an increase of somewhat less than ten per cent over the output of 1906. The complete statistics for 1907, which will soon be published by the United States Geological Survey, show that Mr. Harrison's estimate was conservative, as the actual increase in production was more than 2,000,000 short tons in excess of his estimate. The production for the year showed an increase of 4,410,779 short tons, or 15.91 per cent, in quantity and of $4,978,166, or 16.4 per cent, in value over that of 1906. In 1907 the coal-mining industry in Ohio was not greatly affected by labor troubles or strikes, the car supply was more nearly adequate than in some other states, and the average prices were satisfactory to the operators.

The total production of coal in Oklahoma in 1907 was 3,642,658 short tons, having a spot value of $7,433,914, according to the Geological Survey's annual report on mineral resources of the United States for 1907.

Since the Survey's report for 1906 was published the area included within the territory of Oklahoma and the Indian Territory has been organized and admitted into the Union as the state of Oklahoma. As, however, the entire coal-producing district is included in what was Indian Territory, the production of the state of Oklahoma is co-ordinate with the production of Indian Territory.

The new state began its history of coal production with a noteworthy increase over that of Indian Territory in 1906, when the output amounted to 2,860,200 short tons, valued at $5,482,366. Compared with this the production of 1907 showed an increase of 782,458 tons, or 27.36 per cent, in quantity, and of $1,951,548, or 35.6 per cent, in value. Only three states exceeded Oklahoma in percentage of increase in 1907 over 1906. These were Michigan, whose production increased fifty-one per cent; Arkansas, which had an increase of 43.3 per cent, and New Mexico, with an increase of 33.8 per cent.

The total production of coal in Oregon in 1907 was 70,981 short tons, having a spot value of $166,304.

The Coos Bay field is the only productive coal field in Oregon. It is situated in the southwestern part of the state, in Coos County, and occupies a total area of about 250 square miles, its length north and south being about thirty miles and its maximum breadth at the middle about eleven miles. Among the other coal fields that have been prospected in the state are the Upper Nehalem field, in Columbia County; the Lower Nehalem field, in Clatsop and Tillamook counties; the Yaquina field, in Lincoln County; the Eckley and Shasta Costa fields, in Curry County; the Eden field, in Coos County, and the Rogue River Valley field, in Jackson County—all west of the Cascade Range. None of these fields has been developed to the point of production. Another field lies in the basin of John Day River, east of the Cascade Range, but little is known concerning it. All the fields west of the range, except the Coos Bay, are of rather small area, the largest being the Upper Nehalem, which has an area of less than twenty square miles. The coal of all these fields is lignitic. Its transportation is confined exclusively to Coos Bay and the Pacific Ocean, and San Francisco is the principal market. The Coos Bay field is divided by its structure into six portions—four basins and two arches. The basins are known as the Newport, the Beaver Slough, the Coquille, and the South Slough, and are separated by the Westport and Pulaski arches.

The output of the Tennessee coal mines in 1907 amounted to 6,810,243 short tons, having a spot value of $8,490,334, showing an increase of 550,968 short tons, or 8.8 per cent in quantity, and of $822,919, or 10.73 per cent, in value, over the production in 1906. The average price per ton advanced from $1.22 in 1906 to $1.25 in 1907. About forty per cent of the output of the Tennessee mines is used for railroad fuel, 15 per cent is taken by the comparatively restricted local market of the eastern part of the state, and the rest of the product is marketed in competition with coals from Alabama and southern Kentucky. That the industry did not show greater gain in 1907 was due in part to the exceptionally mild weather in November and December, which caused decrease in the demand for coal for domestic purposes, and in part to added competition from many of the large mines in Virginia, Alabama, West Virginia and Tennessee, forced by the condition of the iron industry to market for steam coal much of their product that would otherwise have been coked. Notwithstanding these adverse conditions, however, the output of the state was the largest ever recorded.

The production of coal in Texas in 1907 was greater by 25.53 per cent, in quantity, and 27.53 per cent, in value, than that of 1906, according to E. W. Parker, of the United States Geological Survey, amounting to 1,648,069 short tons, having a spot value of $2,778,811.

This increase in the coal output is largely the result of the condition of the petroleum industry in the state in the last two years. In 1906 the output of petroleum was sixty per cent less than in 1905 and the coal output showed an increase of 112,189 short tons. In 1907 the production of petroleum was about the same as in 1906, the decrease being insignificant, but the advance in the price of fuel oil in the state was so decided that a number of railroads returned to coal for locomotive use, and the effect on the coal industry is shown by the figures given above.

Coal or lignite was produced in sixteen counties of Texas in 1907, or three more than in 1906. The counties reporting production of bituminous coal—Erath, McCullough, Maverick, Palo Pinto, Parker, Webb and Wise—were the same as in 1906; of the lignite-producing counties—Bastrop, Fayette, Hopkins, Houston, Leon, Medina, Milam, Robertson and Wood—three (Fayette, Lyon and Robertson) were new.

The bituminous and lignite mines in these counties gave employment to 4,227 men in 1907 for an average of 242 days, as compared with 3,048 men for an average of 227 days in 1906. Of the total number, 3,137 men were employed in the bituminous mines for an average of 255 days, and 1,090 in the lignite mines for an average of 204 days. The average production per man per day in the bituminous mines was 1.18 tons, and in the lignite mines 3.18 tons. The average production per man for the year was 300 tons in the bituminous mines and 649.3 in the lignite mines, the average for the state being 390 tons. In most of the bituminous mines the men worked eight hours a day, but in the lignite mines the ten-hour day is the rule. One mine employing sixty men reported nine hours as the length of the working day. Mining machines were used in three mines in 1907, and the product amounted to 36,100 short tons mined with thirteen machines; in 1906 the use of twelve machines resulted in 22,682 short tons of coal.

The total production of coal in Idaho in 1907 was 6,508 short tons, having a

spot value of $26,494. Lignite beds occur in several areas in Idaho, but little mining has been done until within the last five or six years. The producing districts are the Horseshoe Bend and the Jerusalem, occupying the lower portion of a ridge between Boisé and Payette Rivers; an area near Salmon City, in Lemhi County, and one at the eastern edge of the state, in Bingham and Fremont counties, where the Sublette field of Wyoming extends across the state line. The principal production in 1905 and 1906 was in the Salmon district, in Lemhi County, 4,380 tons having been mined there in 1905, and 4,285 tons out of a total of 5,365 in 1906. In 1907 Fremont County was credited with a production of 2,884 tons and 3,500 tons were produced in Lemhi County. Bingham County also produced a small quantity of coal in 1907.

The total production in the state in 1907 showed an increase of 1,143 tons, or 21.3 per cent, in quantity and of $7,956, or 42.92 per cent, in value.

Reception to Farman by the Aero Club.

The Aero Club of America tendered a reception to Henry Farman, the French aeronaut, on the evening of July 30, at the Hotel Astor, New York city. Madame Farman and Mrs. Paul LaCroix received, and the guests were introduced to Mr. Farman by Augustus C. Post. Charles Jerome Edwards welcomed the guest of honor in a speech in which he told of the interest of Americans in Mr. Farman's aeroplane flights. Addresses were also made by several others eminent in aeronautics, the closing address being delivered by Charles J. Glidden, who is widely known in the electrical field and who is an enthusiastic automobilist and aeronaut.

Mr. Farman made a short address, expressing his pleasure at meeting with his brother aeronauts and so many men prominent in social and engineering life, and stated that he had complete confidence that the dirigible aeroplane was a certainty.

One of the interesting features of the evening was the brief address made by Homer W. Hedge, who talked very enthusiastically of the possibilities of the dirigible balloon and explained the formation of the Aero Club of America.

There were a great many electrical men present at this gathering, giving it the aspect of a meeting of one of the electrical engineering societies with which electrical men are so familiar.

Mr. Farman is scheduled to make a series of flights at the Brighton Beach Race Track, Brighton Beach, Brooklyn, N. Y., from August 1 to August 9.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

MONTREAL STREET RAILWAY COMPANY.

The report of earnings of the Montreal Street Railway Company for the nine months ended June 30, 1908, shows that the company did not earn the seven and one-half per cent dividends paid by it during the period. The earnings report indicates that the company either will have to reduce its dividend from the two and one-half per cent quarterly rate during the last quarter of the year or else show a large amount paid out of profit and loss surplus for the year.

The earnings for the nine months ended June 30 show as follows: Gross, $2,672,763; expenses, $1,651,707; net, $1,021,056; charges, $450,876; surplus, $570,180.

During the company's fiscal year ended September 30, 1907, it earned 9.65 per cent on the total $9,000,000 capital stock then authorized. Since the beginning of the current year the authorized capital stock has been increased to $10,000,000. The bonded indebtedness has also been increased by $2,000,000.

UNITED RAILWAYS OF ST. LOUIS.

The gross earnings of the United Railways of St. Louis for the six months ended June 20, 1908, showed a decrease equal to 2.34 per cent, but decreases in expenses and charges brought about an increase equal to 9.39 per cent in net income. The earnings for the six months' period for 1908 are: Gross, $5,163,555; expenses, $3,367,509; net, $1,796,046; charges, $1,385,547; net income $410,499; preferred dividend, $424,580; balance, $14,081.

TOLEDO RAILWAYS AND LIGHT COMPANY.

The report of the Toledo Railways and Light Company for the month of June and six months ended June 30 shows June gross of $201,766; expenses, $107,458; June net, $94,308; other income, $8; total income, $94,316; charges and taxes, $71,762; June surplus, $22,554. Six months' gross, $1,230,375; expenses, $682,388; six months' net, $547,987; other income, $2,783; total income, $550,770; charges and taxes, $420,136; six months' surplus, $130,634.

SEATTLE ELECTRIC COMPANY.

The report of the Seattle Electric Company for the month of May and twelve months ended May 31 shows May gross of $386,961; expenses, $216,858; May net, $170,103; charges, taxes and sinking fund, $87,431; May surplus, $82,672. Twelve months' gross, $4,365,709; expenses, $2,593,833; twelve months' net, $1,771,876; charges, taxes and sinking fund, $1,001,398. Twelve months' surplus, $770,478, a decrease of $38,159 as compared with the same period a year ago.

NORFOLK & PORTSMOUTH TRACTION.

The report of the Norfolk & Portsmouth Traction Company for the month of June and six months ended June 30 shows June gross of $164,526; expenses, $98,622; June net, $65,904; six months' gross, $875,619; expenses, $574,535; six months' net, $328,084.

BOSTON & WORCESTER STREET RAILWAY.

The gross earnings of the Boston & Worcester Street Railway Company for June were $54,500, the largest in the current fiscal year, and 3.6 per cent larger than in the corresponding month a year ago. The gross earnings on the main line last month showed an increase of seven per cent, but the business on the branch lines, which is local in character and in mill towns, showed a decrease, compared with a year ago, owing to the industrial depression.

MICHIGAN STATE TELEPHONE COMPANY.

The Michigan State Telephone Company's report for the six months ended June 30 shows gross earnings of $1,648,984; expenses, $1,211,252; net earnings, $437,732; interest, $208,935; balance, $228,797; dividend on preferred stock (six per cent), $68,498; surplus, $160,299.

NASHVILLE RAILWAY AND LIGHT COMPANY.

The report of the Nashville Railway and Light Company, Nashville, Tenn., for the month of June and six months ended June 30 shows June gross of $130,994; expenses and taxes, $73,622; interest charges, $32,069; reserve and sinking fund, $3,921; surplus, $12,623. Six months' gross, $760,050; expenses and taxes, $464,183; interest charges, $188,061; reserve and emergency fund, $22,670; six months' surplus, $85,136.

AMERICAN LIGHT AND TRACTION COMPANY.

The report of the American Light and Traction Company for the six months ended June 30 shows net earnings of $2,499,257, an increase of $186,292, and a final surplus after allowing for dividends and reconstruction reserve of $538,853, an increase of $116,597. The total surplus now stands at $3,196,257.

MEMPHIS STREET RAILWAY COMPANY.

The Memphis Street Railway Company, of Memphis, Tenn., for the month of

June and six months ended June 30 shows June gross of $140,882; expenses and taxes, $87,092; interest charges, $34,876; reserve and emergency fund, $2,500; June net surplus, $16,414. Six months' gross, $775,067; expenses and taxes, $494,401; interest charges, $208,439; reserve and emergency fund, $15,000; six months' net surplus, $57,227.

CUMBERLAND TELEPHONE AND TELEGRAPH.

The report of the Cumberland Telephone and Telegraph Company for the month of June and six months ended June 30 shows June gross, $504,364; expenses, $292,209; June net, $212,155; charges and taxes, $35,374; June surplus, $176,781. Six months' gross, $3,056,978; expenses, $1,782,208; six months' net, $1,274,770; charges and taxes, $223,018; six months' surplus, $1,051,760.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY.

The comparative statement of earnings and expenses of the American Telephone and Telegraph Company for the month of June and six months is as follows:

Month of June—

	1908.	1907.
Interest and other revenue	$815,351	$603,243
Telephone traffic (net)	326,237	283,161
Real estate	13,156	12,814
Other sources	40,296	42,399
Total	$1,195,040	$941,617
Expenses	203,590	181,974
Net earnings	$991,450	$759,643
Interest	647,540	579,346
Balance	$343,910	$180,297

January 1 to June 30—

Dividends	$6,443,344	$5,685,089
Interest and other revenue	4,951,788	3,813,182
Telephone traffic (net)	1,995,864	1,832,114
Real estate	55,735	37,541
Other sources	341,658	200,845
Total earnings	$13,785,391	$11,568,772
Expenses	1,073,770	1,032,569
Net	$12,714,621	$10,536,203
Interest	3,871,675	3,439,791
Surplus	$8,842,945	$7,096,411
Dividends April-July	6,120,092	5,262,056
Net surplus	$2,722,853	$1,834,355

DENVER CITY TRAMWAY COMPANY.

A meeting of the stockholders of the Denver City Tramway will be held August 27 to authorize an issue of $25,000,000 five per cent thirty-year mortgage bonds, to be used for the following purposes: To refund the present outstanding indebtedness; to acquire all or any part of the property and assets of the Denver & Northwestern Railway Company and the Denver Tramway Power Company and to pay off or exchange for the outstanding bonds of these two companies, as well as to provide funds for future extensions, additions and improvements to the company's lines.

DETROIT UNITED RAILWAY COMPANY.

During the six months ended June 30, 1908, the Detroit United Railway earned an amount equal to 3.12 per cent on its $12,500,000 outstanding capital stock. This compares with an amount equal to 3.52 per cent earned during the first six months of 1907.

The reason for the less favorable showing this year is found in the heavy increase in charges, the increase being equal to 5.71 per cent. This increase was the principal cause for a decrease equal to the 11.37 per cent in the surplus after charges.

Below are shown the earnings for the six-month periods for both 1908 and 1907:

	1908.	1907.
Gross	$3,285,428	$3,286,869
Expenses	2,110,307	2,105,239
Net	1,175,121	1,181,630
Other income	28,609	28,239
Total income	1,203,730	1,209,869
Charges	812,973	769,078
Surplus	390,757	440,791

As the company's best months are those of July, August and September, a better showing for the last half of the year can be expected. During the year ended December 31, 1907, the company earned 8.88 per cent on its $12,500,000 capital stock. The amount available for dividends was equal to 6.71 per cent after the deduction of depreciation charges.

UNION TRACTION OF INDIANA.

Secretary William H. Forse, Jr., of the Union Traction Company of Indiana, in a circular to stockholders states that, owing to general business depression and a strike of a portion of the company's employés during January and February, gross earnings of the Indiana Union Traction Company for the year ended June 30, 1908, from all properties except those leased after June 15, 1904, do not amount to $1,850,000, and therefore no rental, based on gross earnings for such period, will be payable.

MASSACHUSETTS ELECTRIC COMPANIES.

The report of the Massachusetts Electric Companies for the quarter ended June 30 shows gross receipts of $5,328,088, an increase of $162,613 over the corresponding period last year. Net earnings after fixed charges show a gain in gross of $117,887, or 65.2 per cent. For the nine months operating expenses absorbed 68.7 per cent gross, compared with 71.4 per cent for the same three quarters of 1907.

PHILADELPHIA RAPID TRANSIT COMPANY.

While the annual report for the fiscal year ended June 30 of the Philadelphia Rapid Transit Company has not been made public, it is understood that the company carried 512,869,053 passengers during the year, an increase of 20,732,015. With the completion of the new elevated and subway line through the centre of the city it is estimated that traffic next year will show a much larger increase. Gross earnings were $18,288,000. Operating costs were a trifle higher, and the company will show a deficit for the year of approximately $92,000, as compared with last year's deficit of $364,048. With the payment of the remaining $7.50 due on September 7, the stock will be full paid and non-assessable. The payment of this assessment of $4,500,000 will clean up existing loans of $3,000,000 or more, and all payments on construction work.

TWIN CITY RAPID TRANSIT COMPANY.

The report of the Twin City Rapid Transit Company for the six months ended June 30 shows gross earnings of $2,982,849; expenses, $1,535,589; net earnings, $1,447,260; charges and taxes, $644,427; surplus for dividends, $802,833; preferred dividend, $105,000; balance for common stock, $697,833.

LITTLE ROCK RAILWAY AND ELECTRIC COMPANY.

The Little Rock Railway and Electric Company reports for the month of June and six months ended June 30 as follows: June gross, $54,046; expenses and taxes, $30,270; interest and sinking fund, $10,205; reserve and emergency fund, $3,000; net surplus, $10,570. Six months' gross, $330,732; expenses and taxes, $168,622; interest and sinking fund, $58,000; reserve and emergency fund, $18,000; six months' net surplus, $86,110.

BIRMINGHAM RAILWAY, LIGHT AND POWER COMPANY.

The Birmingham Railway, Light and Power Company, of Birmingham, Ala., reports for the month of June and six months ended June 30, June gross of $194,293; expenses and taxes, $118,647; interest and sinking fund, $43,846; June surplus, $31,800. Six months' gross, $1,064,825; expenses and taxes, $682,777; interest and sinking fund, $263,295; six months' surplus, $118,753.

KNOXVILLE RAILWAY AND LIGHT COMPANY.

The Knoxville Railway and Light Company, Knoxville, Tenn., reports for the month of June and six months ended June 30, June gross of $48,977; expenses and taxes, $24,933; interest charges, $11,421; surplus, $12,623. Six months' gross, $272,099; expenses and taxes, $144,697; interest charges, $68,677; surplus, $58,725.

ELECTRICITY IN AGRICULTURE.[1]

BY SIR OLIVER LODGE.

Some thirty years ago a Swedish professor named Lemström sought to elucidate the aurora borealis by trying to imitate its appearance by electrical experiments. For this purpose he produced high-tension discharges of various kinds, and sent them through vacuum tubes until he got an appearance very like those of the northern lights. Some of these experiments he conducted in his greenhouse, and he noticed incidentally that the plants seemed to thrive under the treatment, and that the electrification thus produced in their neighborhood appeared to do them good. He also noticed, as remarkable, the flourishing development of plants in arctic regions, where the sunlight was very weak, and he attributed part of this growth to the influence of electric discharges.

He says that when the plants in the north of Norway, Spitzbergen and Finnish Lapland have resisted the frequently destructive night frosts they show a degree of development which greatly surpasses that of plants in more southern regions, where the climatic conditions are more advantageous. This rich development appears principally in the fresh and clear colors of the flowers, in their strong perfume, in the rapid development of the leaves on the trees, and their scent, but particularly in the rich harvest which different seeds—such as rye, oats and barley—will produce when, as before stated, they are not destroyed by the frosts. From a bushel of rye sown they will often produce forty bushels, and from barley twenty bushels, and so forth. It is the same with grass. These results are attained although the people cultivate their soil very imperfectly, using only plows and harrows of wood.

He pursued the matter by careful observation, taking test plants in pairs or groups, electrifying one group—that is to say, discharging some electricity into the air above them—and keeping a similar group away from the electricity, in order to be able to compare them. Then he photographed the two groups side by side, and found in nearly all cases a marked improvement as the result of the electrical treatment. He concluded that the needle-like shape of the leaves in fir trees, and the beard on the ears of most cereals, had the discharge of electricity as their function, and found that they did act in this way.

It can hardly be doubted that the electrification of the air has some effect on growing plants. For it is found that, under the influence of sunshine, electrified plants can give off electricity into the air from the leaves, and the fact that the air is electrified relatively to the soil requires that the plants shall be electrified too, so that in all probability they are in a constant state of slow electrical discharge, which becomes more rapid when the sun is up. In what way this discharge of electricity from their growing tips and hair, and surface generally, really acts must be studied and reported on by physiological botanists; but it is natural to suppose that it can not be without influence and reasonable to think that that influence must be beneficial—a hypothesis which direct experiment confirms.

When, after some preliminary experiments at Bittin, J. E. Newman, of Gloucester, acting in conjunction with R. Bomford, of Salford Priors, determined to try the phenomenon on a really large scale, and came to me to see if I could help them electrically, and enable them to maintain a continuous high-tension discharge for hours together each day over ten or eleven acres by means of power furnished by an oil engine and dynamo, I very willingly assented and set my son, Lionel Lodge, upon the job.

The method is to stretch over the field to be treated a number of wires on poles, high enough for loaded wagons and all the usual farming operations to go on underneath the wires without let or hindrance. The wires are supported on the posts by elaborate high-tension insulators and they extend over all the acreage under experiment, a control plot of similar land under similar conditions being, of course, left without any wires.

The system of conductors is then connected at one post with a generator supplying positive electricity at a potential of something like 100,000 volts and with sufficient power to maintain a constant supply of electricity at this kind of potential.

Leakage immediately begins, and the charge fizzes off from the wires with a sound which is sometimes audible, and with a glow which is visible in the dark. Any one walking about below the wires can sometimes feel the effect on the hair of the head, as of a cobweb on the face. They are then feeling the stimulating action of the electrification.

The electrification is maintained for some hours each day, but is shut off at night; it is probably only necessary to supply it during the early morning hours in summer time, and in spring time or in cold cloudy weather for the whole day, or during the time of the plant's greatest activity. But at what stages of the growth of a plant the stimulus is most effective has still to be made out. However, in the case of wheat, both the ear and the straw are valuable, and the electrification is accordingly applied for a time each day during the whole period of growth until stooling begins.

The power required to generate the electricity is very small, for although the potential is high the quantity is insignificant, and the energy is accordingly comparatively trivial. It is known that even when natural atmospheric electricity has accumulated intensely, and has become a thunderstorm, the quantity even then is quite small, though the potential or tension is so enormous that the flashes are of astonishing violence and power while they last.

The electricity can be generated in more than one way. It can be generated by the revolving glass plates of a static influence machine, usually known in this country as a Wimshurst machine, or it can be generated by transforming up to high tension and rectifying to one direction the current of the revolving magnetic generator called a dynamo. The first is in many respects the simplest and was used in the early and small-scale experiments, but it can hardly be regarded as an engineering method adapted to continuous or rough use. The latter is the one which in the trials now to be described we have adopted.

The power is generated by a two-horse oil engine driving a small dynamo in an outhouse of the farm. Thence the current (three amperes at 220 volts) is taken by ordinary overhead wires to the field where they enter a suitable weather-tight hut which contains the transforming and rectifying apparatus. The only moving part here is the "break" and if the original dynamo had been an alternator even this might have been dispensed with. The transformer is a large induction coil specially made to stand continuous use and its current is rectified by means of vacuum valves in accordance with a patented device of my own.

The negative electricity is conveyed direct to earth, while high-tension electricity, all of positive sign, is led by a specially insulated conductor out of the shed to the nearest post of the overhead insulated wires, which are thereby maintained at continuous high positive potential.

The overhead system of wires covered

[1] Abstract.

about nineteen and one-half acres of ground. The wires were mounted on insulators placed upon larch poles some fifteen feet high, which were placed in rows, the rows being separated by a distance of 102 yards and the poles in a row being seventy-one yards apart. Stout telegraph wire carried the current down each row, while thin galvanized-iron wires, placed some twelve yards apart, were stretched between the rows, and acted as the discharge wires. In this way twenty-two poles were sufficient to support the wire over the nineteen acres. Roughly, only one pole per acre is required, therefore the inconvenience is practically *nil*.

Owing to the flexible suspension, risk of breakage to the wires is very small. During the two years the wires have been up at Bevington, apart from a few wires broken at harvest time by catching the top of an extra high wagon load, only one wire has fallen.

The acreage was spread over two different fields: In one field some eleven acres of wheat were under treatment; in the other six and one-half acres of barley and a half-acre plot planted with potatoes, mangolds, etc.

The wheat field was of eighteen and one-half acres extent, the remaining seven acres were sown with English (White Queen) wheat, one and one-half acres, and Canadian (Red Fife) on five and one-half acres. In the electrified part Canadian wheat occupied two and one-half acres, English wheat nine acres.

The results on the barley field, including the small plot, had to be neglected owing to the great local variations produced by the very irregular manuring the field had previously undergone; the wheat field, however, as far as one could judge, had been very uniformly treated previously.

In the wheat, a difference was noticeable at an early stage, the young blades on the electrified part being, in the opinion of many observers, of a darker green.

The crop was judged as considerably heavier by several practical observers, and the straw was, on an average, from four inches to eight inches higher. Both experimental and control plots came into ear at about the same time, but the Canadian wheat under treatment was ready for cutting some three or four days before the control area.

The following is a very brief summary of returns and information supplied to me by Mr. Newman and Mr. Bomford, showing the results from the electrified as compared with the control unelectrified plots.

SUMMARIZED RESULTS OF THE 1906 EXPERIMENTS.

Bushels of wheat per acre.

(Estimated corresponding increase in straw not measured.)

	From the Electrified Plot.	From the Unelectrified Plot.	Increase. Per Cent.
Canadian (Red Fife)	35½	25½	40
English (White Queen)	40	31	30

Moreover, the electrified wheat sold at prices some seven and one-half per cent higher, several millers in baking tests finding that it produced a better baking flour.

The increase appears to be mainly due to better stooling. No marked difference was observable in the development of ears.

J. Kirkland, of the National School of Bakery, Borough Polytechnic, found the evidence from baking tests supported by the average of dry glutens from all his tests thus:

	Per Cent.
In the electrified	11.15
In the unelectrified	10.35

The somewhat poor yield of wheat obtained from the unelectrified portion of the field is probably explained by a deficiency in lime, which has now been rectified. Further, the wheat was spring sown, and red fife, under this condition, does not usually yield good crops. The experiments are being repeated upon wheat during the present season, and strawberries are also under treatment once more.

In 1907 wheat was grown again in the 1906 wheat field. Current was cut off from most of the barley field, which was down to clover and rye grass; eight and one-quarter acres in an adjoining field were planted with strawberries (Stirling Castle) in March, approximately two and three-quarters acres having a wire network erected over them. Mangolds were planted between the strawberry rows.

The wheat field during the early spring was given a dressing of lime, ten hundredweight to the acre, four hundredweight to the acre, bone meal drilled in; the unelectrified part was given one and one-half hundredweight sulphate of ammonia, and the electrified part three-quarters hundredweight. Barley had been grown on the strawberry field in 1906, and this was given ten tons to the acre of farmyard manure, which was plowed in.

RESULTS OF CROPS, 1907.

WHEAT.

(Variety—Red Fife, Spring Sown.)

Seven and one-half acres unelectrified gave 239 bushels thirty-eight pounds head wheat, fifteen bushels one pound tail.

Eleven acres electrified gave 455 bushels fifty pounds head wheat, seventeen bushels twenty-seven pounds tail.

Or, summarizing as follows:

BUSHELS PER ACRE (HEAD WHEAT).

Electrified, 41.4; unelectrified, 32; increase 29 per cent.

Electrified wheat brighter and a better sample. Increase due to better stooling and also better filling out of ears.

HOURS PLANT RUNNING.

1906, March 16 to July 10, inclusive; 621¾ on ninety days. Average electrical pressure corresponded to a three-quarters-inch spark.

1907, March 28 to July 27, 1,014 hours on 115 days. Average pressure corresponded to a one-half-inch spark.

STRAWBERRIES.

This being the first year, the crop was necessarily very small, and was picked chiefly to see if any increase had been obtained. The result showed a thirty-five per cent increase. Earlier ripening was also observed.

Mangolds—It was found impossible to weigh either the whole or a part of this crop. Estimated increase (from number of cartloads removed) twenty-five per cent. Analysis showed an increase in the sugar where electrified, but the results varied considerably.

Small plots of raspberry canes showed a marked improvement in growth. A curious point about the raspberries was that the foliage and fruit on the old canes showed no difference, but that the new growth, particularly after the old wood was cut back, showed an enormous difference in favor of the electrified. The manurial treatment was exactly similar.

Small plots of tomatoes also showed a large increase in the crop.

Those interested in the experiments are much indebted to the enthusiastic co-operation of Mr. Bomford. It may be interesting to note that it was at a farm belonging to Mr. Bomford's father that the first steam plowing in England was done.

Professor Lemström is undoubtedly the pioneer in this sort of work; though circumstances connected with the natural electrification of the atmosphere and with the discharge of electricity from various surfaces have been pertinaciously examined by Professors Elster and Geitel.

Professor Lemström published his results with full details and illustrations, both of the apparatus used and of the appearance of some of the resulting crops, in a small book called "Electricity in Agriculture and Horticulture," published in English by the Electrician Company, in 1904, and is well worth referring to.

The Abbé Berthelon, in 1783, raised a head of metallic points in the air, in

the manner of a lightning conductor, and made it terminate in a series of discharge points just over the plants. He states that the use of this apparatus was invariably accompanied by an improvement in the appearance of the vegetation and by an increase in the fertility of the plants.

An opposite or control experiment was made by Grandeau in 1879 when he protected a plant from atmospheric electricity by means of a wire cage, and showed that its development was greatly retarded.

Other experimenters have done the same thing and made careful measurements of the results, which are all in the same direction.

Professor Berthelot compared the growth at the top of a twenty-eight-metre tower with that of plants growing at the foot, and considered that the greater growth at the higher level was largely due to the potential gradient in the atmosphere.

Dr. Cook, of Bristol, likewise obtained an increase in the rate of growth by the use of an overhead discharge on a small scale.

During the winter of 1904 Mr. J. E. Newman installed a small trial apparatus, consisting of a small influence machine of the Wimshurst type and overhead discharge wires, at the Golden Valley Nurseries at Bitton, near Bristol. The wires ran about sixteen inches above the tops of the plants, or above the rows of tomatoes in the glass houses, and short pieces of fine wire, with the free ends pointing downward, acted as discharge points.

From March 7 to July 26 the machine was running during 108 days for a period of 9.3 hours daily, principally at night.

In all cases control plots were provided, which, as far as practicable, were under identical conditions, and the very favorable results obtained led to the experiments on a larger scale above described.

The Annual Convention of the Brilliant Electric Company.

The annual convention of the officers, sales managers and representatives of the Brilliant Electric Company was held at Cleveland, Ohio, July 18, 19 and 20, headquarters being established at the Colonial Hotel. The three days' convention included business sessions and excursions to various points of interest for rest and recreation. On the morning of July 18 the representatives made a visit to the enginering department of the National Electric Lamp Association, where an address was delivered by Chief Engineer S. E. Doane. Later in the morning a trip was made on special cars to the Gates Mills, where luncheon was served, after which a baseball game was played between the jobbers and the salesmen. In the evening dinner was served at the Colonial Hotel, and addresses made as follows: "The Brilliant Electric Company," by M. H. Nason, vice-president of the company; "The Brilliant Lamp from a Jobber's Standpoint," C. K. Crossan, president of the Sweeten-Crossan Electric Company; "The Tungstolier," Milton Hartman, manager of the Tungstolier department; "Co-operation with the Jobber," by F. B. Galloway, of Cleveland; "The Diagnosis of a Lamp Man," by E. V. Hennecke, of Cleveland; "Modern High-Efficiency Illuminants," Herman Akhurst, of Cleveland; "Personality as a Business-Getter," D. W. Hopper, of Cleveland. The evening session was closed with an address by E. J. Kulas, secretary and general manager of the company.

On Sunday, July 19, the party made a trip on the steamer Eastland to Cedar Point.

On Monday, July 20, breakfast and luncheon were served at the Breakers Hotel, Cedar Point. In the afternoon the party left Cedar Point, and dinner was served at the Colonial Hotel, in Cleveland. At 9 P. M. there was a farewell supper at the Hofbrau, most of the members of the party leaving for Buffalo, where the jobbers' meeting was held.

Among those present were the following:

Herman Akhurst, Brilliant Electric Company, Cleveland, Ohio.

F. C. Barrington, Columbian Electrical Company, St. Joseph, Mo.

F. M. Bernardin, B-R Electric and Telephone Manufacturing Company, Kansas City, Mo.

M. G. Campbell, B-R Electric and Telephone Manufacturing Company, Kansas City, Mo.

E. E. Chase, Brilliant Electric Company, Cleveland, Ohio. Tungstolier department.

Thomas M. Cluley, Union Electric Company, Pittsburg, Pa.

Thomas Creaghead, Creaghead Engineering Company, Cincinnati, Ohio.

C. K. Crossan, Sweeten-Crossan Electric Company, Philadelphia, Pa.

H. H. Cudmore, Ambos-Cudmore Company, Cleveland, Ohio.

H. C. Downing, Downing Electric Company, Fort Dodge, Iowa.

G. O. D'Urfae, Brilliant Electric Company, Cleveland, Ohio.

F. B. Galloway, Brilliant Electric Company, Cleveland, Ohio. Tungstolier department.

L. Grieser, Cleveland Electrical Supply Company, Cleveland, Ohio.

Milton Hartman, Brilliant Electric Company, Cleveland, Ohio. Tungstolier department.

W. J. Hartwig, W. J. Hartwig Company, Detroit, Mich.

E. V. Hennecke, Brilliant Electric Company, Cleveland, Ohio.

H. B. Hewett, Cooper-Hewett Company, Louisville, Ky.

D. W. Hopper, Brilliant Electric Company, Cleveland, Ohio.

J. H. Hughes, E. B. Latham & Company, New York city.

W. C. Jones, Union Electric Company, Pittsburg, Pa.

L. H. Keller, Union Electric Company, Pittsburg, Pa.

E. P. Kinney, Capitol Electrical Engineering Company, Lansing, Mich.

A. C. Knight, Brilliant Electric Company, Cleveland, Ohio. Tungstolier department.

G. A. Knoche, Dunham, Carrigan & Hayden Company, San Francisco, Cal.

C. F. Koepge, Brilliant Electric Company, Cleveland, Ohio.

E. J. Kulas, Brilliant Electric Company, Cleveland, Ohio.

C. E. Ludovici, E. B. Latham & Company, New York city.

M. McGraw and representative, Interstate Supply Company, Sioux City, Iowa.

F. C. Maxheimer, Cleveland Gas and Electric Fixture Company, Conneaut, Ohio.

M. H. Nason, Cleveland, Ohio.

G. W. Provost, Union Electric Company, Pittsburg, Pa.

J. P. Provost, Union Electric Company, Pittsburg, Pa.

W. S. Reynolds, Brilliant Electric Company, Cleveland, Ohio. Tungstolier department.

Mark Simonton, Electric Supply and Construction Company, Columbus, Ohio.

F. D. Sweeten, Sweeten-Crossan Electric Company, Philadelphia, Pa.

R. H. Westbrook, Westbrook Brothers & Company, Greensboro, N. C.

One of the interesting features of the convention was the issue of "Daily Doings," published each day during the meeting. This contained the official programme and a great deal of interesting matter, personal and otherwise. The bulletin was edited by Milton Hartman, of the Tungstolier department, and contributed greatly to the success and enjoyment of the meetings.

THE TEST-METER METHOD OF TESTING SERVICE METERS—I.

BY JOSEPH B. BAKER.

The testing of meters at their places of installation by the use of indicating instruments is accurate, but is slow and correspondingly expensive.

The most serious disadvantage of the indicating-instrument and stop-watch method is the great amount of computation which is involved. The two sets of factors entering into the calculation—the disc constant of the meter and the number of seconds required for the disc to make a given number of revolutions, and the amperes and volts as read by the indicating instruments—must be reduced to watts in order to make them comparable. This operation may be summarized briefly as follows: The disc revolutions are multiplied by the meter's disc constant to obtain watt-hours, and this again multiplied by 3,600 to reduce to watt-seconds. This product is then divided by the number of seconds recorded on the stop-watch to obtain the watts recorded by the meter, which is then compared with the true watts, found by multiplying together the instrument amperes and volts. The computation is usually performed on a slide rule and occupies two or three minutes.

In order to facilitate the making of routine tests, *i. e.*, shorten the time and lessen the labor required to make the house-to-house tests without sacrifice of accuracy, standard rotating wattmeters have been employed instead of indicating instruments. In this method of testing as formerly practiced a carefully calibrated meter of the same capacity and disc speed as the consumer's meter is connected in circuit with the latter and the number of revolutions made by the two meters in a given time observed on a stop-watch; the test load being either the consumer's regular load or a determined load given by a lamp bank or rheostat. The portable standard was usually suspended from the consumer's meter by adjustable chains.

In the early method of comparison and calibration the main fields of the "standard meter" were connected immediately in series with the main fields of the consumer's meter and its potential circuit in parallel with that of the consumer's meter, so that one meter (A) was next to the mains and the other meter between A and the load. After throwing on the load (usually the consumer's regular load) the two discs, previously held still, were allowed to start at the same instant, and the "gain" of one over the other as the discs revolved was readily observed by sighting on marks on the edges of the two discs. After a few revolutions it became apparent whether the meter under test was "fast" or "slow," and the necessary cleaning of the consumer's meter, replacing of its jewel, adjustment, or what not, was done until the two discs ran in synchronism. Allowance was made, of course, for the lower registration of the meter which was next the load, due to the watts lost in the other meter. This method of testing was regarded as especially convincing to the customer whose meter was being tested, since the method was more comprehensible to him than a test by indicating instruments; but it was deemed advisable to connect his meter between the standard meter and the load, rather than the other way about, in order that he should not observe his meter to be running faster than the standard, when it was declared by the tester to be adjusted properly!

The time required to test a consumer's meter by this method is short compared to the time required to test with indicating instruments; and the procedure is simple, inasmuch as no error is introduced by variation of either load or potential (as on a motor load, for example), and there are no swinging instrument pointers to make readings difficult. On the other hand, a disadvantage of the method for routine testing as originally practiced was that it necessitated the daily checking and transportation of as many test meters as there were different capacities of customers' meters to be tested; since otherwise the tester must reduce the revolutions of the standard meter to an equivalent number on the meter under test, by slide-rule or pencil computations.

Sources of Error—Following are the principal sources of error in the use of a rotating wattmeter for testing, in the order of their importance. The sources of error, as stated, apply more particularly to direct-current meters of the commutator type:

(1) Differences in friction and vibration, especially when the test meter is running on light load. The uncertainty, as to accuracy on light load, of the portable standard—which was, of course, inherently quite as great as in the consumer's meter, under ordinary conditions, due to the magnitudes of the possible change in commutator and jewel friction as compared with the torque—was one of the two main disadvantages of its use for testing; the other being the need of having as many portable standards as there were sizes of consumers' meters installed. Changes in commutator friction may change the accuracy on one-tenth load as much as ten per cent in one day, and any heavy vibration, such as that caused during the test by a passing truck or trolley car, may change the accuracy for the time being to a very serious extent.

(2) Using the test meter before the potential circuit has had time to warm up to normal operating temperature, corresponding to the temperature of the consumer's meter. The test meter runs fast when first connected to the circuit, due to the fact that it is disconnected for a relatively long time, and thus has time to cool down, between the tests made at successively visited installations.

(3) Connecting the test meter on the wrong polarity, thereby causing error, especially on light loads, due to the stray fields from the braking magnets.

(4) Heat radiated by the series fields of the test meter when carrying a heavy load for a considerable length of time. This heat increases the resistance of the armature, causing it to run slightly slower.

It will be noted that the test-meter method possesses decided points of merit, while its disadvantages are mechanical and external, rather than inherent in the testing principle involved; so that if the disadvantages could be removed, the method, consisting as it does of a direct comparison of the consumer's meter with a standardized apparatus of identical type, would become an almost ideal way—accurate, quick and inexpensive—of testing a large number of consumers' meters in succession.

MODERN COMMERCIAL TEST METERS.

The manufacturers of the commercial test meters of the present day have sought to realize the advantages and eliminate the sources of error above described, by working along the following two separate and distinct lines:

A. The composite field construction and method exemplified in the Mowbray, Thomson and Fort Wayne test meters.

B. The method of employing a rotating standard meter of the same type and adjustable to the same capacity as the service meter to be tested, as exemplified in the Westinghouse multiple field rotating standard. An account of these three commercial test meters will be given in subsequent articles.

The Extension of the Telegraph.

From statistics made public by the German Government the following data have been compiled comparing the extent and cost of telegraph service in the various countries of greatest importance in the year 1906:

The United Kingdom leads in the number of messages sent—94,000,000; the United States has, however, the greatest number of miles of line—1,155,480; France has the lowest average cost of message—twelve cents.

	No. of Messages in Millions.	Average Cost per Message.	Total Receipts.	Miles of Line.
United States	65.5	$0.42	$27,985,000	1,155,480
United Kingdom	94.0	.16	15,247,000	384,109
France	58.0	.12	7,334,000	389,002
Germany	52.5	.15	8,299,000	458,358
Austria	19.0	.14	2,702,000	133,549
Italy	16.0	.21	3,472,000	128,582
Spain	5.0	.32	1,640,500	47,923

Statistics of Russia, Japan and other countries are incomplete.

The Brusio Hydroelectric Plant and Its 50,000-Volt Swiss-Italian Transmission System.

By Frank Koester.

THE largest and most recent hydroelectric installation in continental Europe is that at Brusio in the southeastern corner of Switzerland. Some 3,155 feet above sea level, bordered by the slopes of the Bernina Mountains, lies the lake of Poschiavo. This lake receives, among others, the waters of the River Poschiavino and its tributaries as well as those of the River Cavagliasco, which in turn collects the waters of the glaciers Cambrena and Palü. The total drainage area which feeds this lake is seventy-seven square miles. The area of the lake is 0.77 square mile and its greatest depth is 260 feet.

Owing to the high altitude of the lake the water supply in the winter time will be considerably less than during other seasons, consequently the equipment of the plant with proper regulating devices became very essential. Therefore one of the foremost requirements consisted in damming the lake at its outlet, where the normal level, thus providing a natural reservoir giving a reserve water supply of 520,000,000 cubic feet.

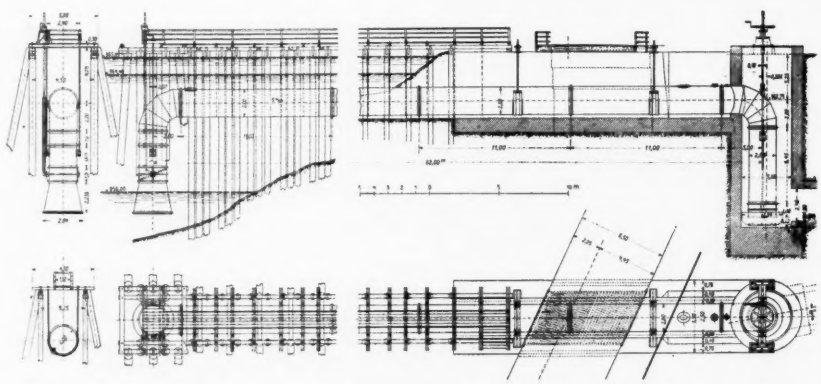


FIG. 1.—SIPHON SYSTEM AT LAKE POSCHIAVO POWER PLANT, BRUSIO, SWITZERLAND.

The headrace leading from the lake is carried to Monte Scala, a distance of 3.25 miles, by a tunnel through the mountain at a considerable depth, where a collecting basin is provided. The power plant is located at Campocologna, receiving the water through penstocks from the collecting basin under a head of 1,300 feet.

Current is generated at 7,000 volts and is transmitted through a tunnel across the boundary into Italy, where, at a substation in Piattamala, the voltage is stepped up to 50,000 for use by the Societa Lombarda, an Italian distributing company, to work in parallel with their well-known stations in Vizzola and Castellanza. This company guarantees the use of 16,000 kilowatts. From the power plant itself several aerial lines transmit current to various other consumers in Switzerland, and among them it will assist a small

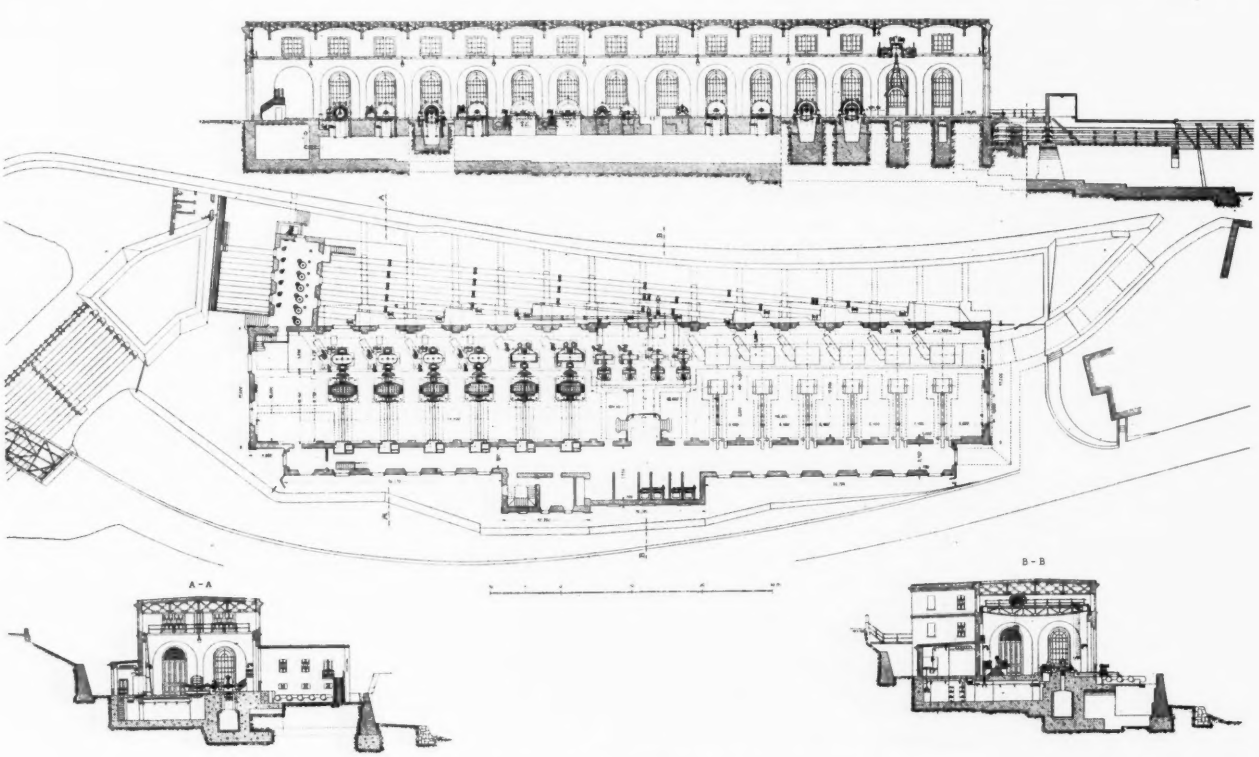


FIG. 2.—GENERAL LAYOUT OF POWER PLANT, BRUSIO, SWITZERLAND.

River Poschiavino continues, so that the water level of the lake may be raised 3.3 feet above the normal and lowered by siphoning as much as 24.3 feet below the

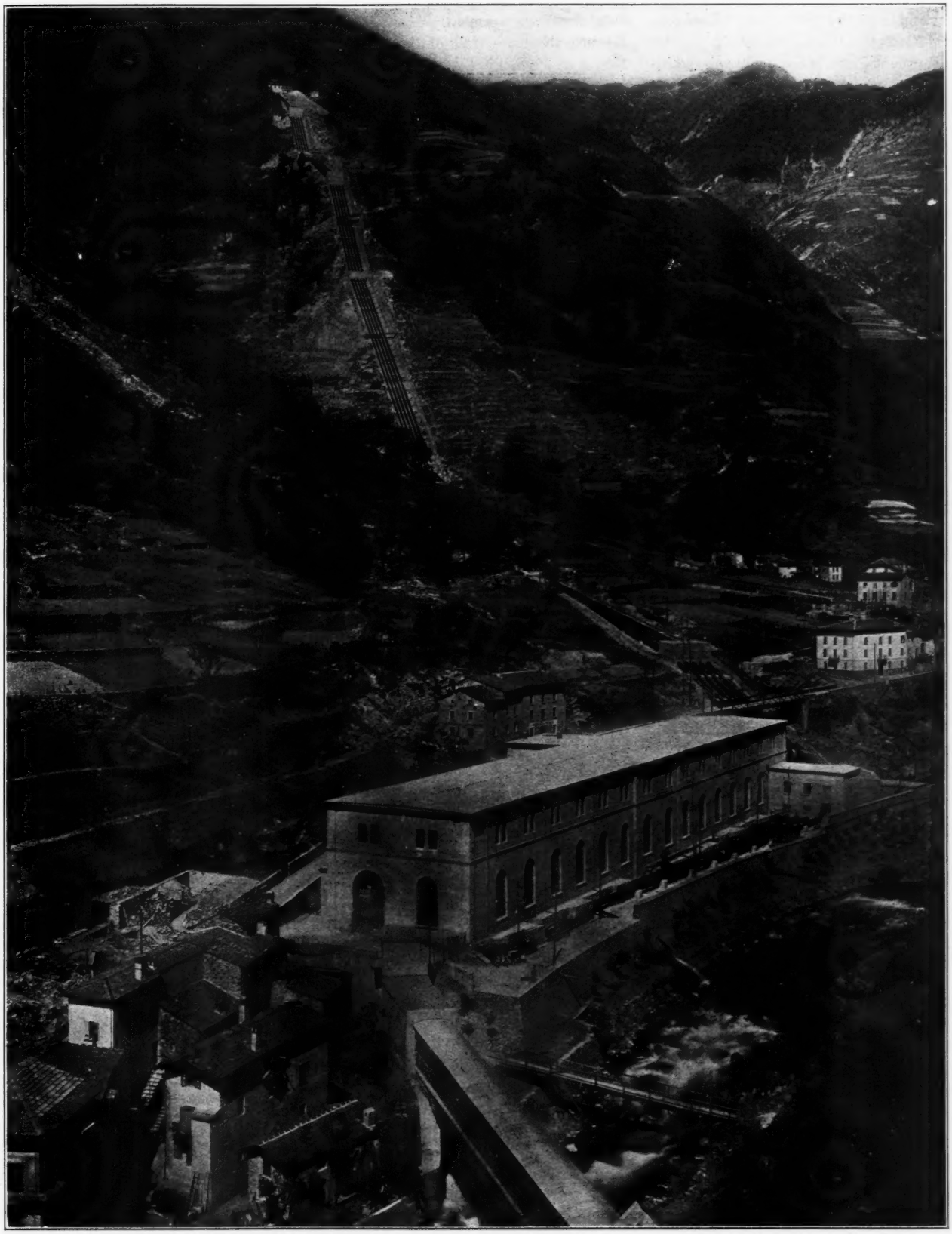


FIG. 3.—POWER PLANT AT BRUSIO, SWITZERLAND, SHOWING ALSO PENSTOCKS AND CABLE TUNNEL.

power plant still under construction at Sajento.

The 40,000-volt transmission line, from Piattamala to the substation at Lomazzo, is 88.5 miles in length and consists of two independent lines. A 20,000-volt transmission line branches off northward to Como from the station at Lomazzo, running a distance of thirty miles. An 11,000-volt line runs southward eight and one-half miles to the steam-power plant at Castellanza for assisting or drawing current from same. The bulk of the current is used for spinning and weaving mills, which begin operations at 7 A. M.; reaching its maximum in a half hour, the load remains steady up to 12 o'clock noon, dropping in thirty minutes to a few hundred kilowatts and again reaching its maximum at 1 P. M., where it remains up to 7 P. M. During the night only 2,000 kilowatts are necessary.

The entire hydroelectric development and transmission system is considered the most up-to-date in Europe, embodying many excellent examples of modern European practice.

SIPHON SYSTEM.

As the level of the water in the lake will vary in the neighborhood of thirty feet, the headrace tunnel is located 32.8 feet below the normal water level. It was not advisable to connect the tunnel directly with the bed of the lake, therefore a siphon was installed. For this purpose a shaft was sunk about seventy-five feet from the water's edge and carried 7.4 feet below the low-water level. The shaft is twelve feet in diameter and the portion below water-level was built under air pressure. From this shaft the headrace or supply tunnel, having a diameter of 8.9 feet at this point, leads to the collecting basin.

The lake is connected to this shaft by means of a siphon tube 6.5 feet in diameter and 270 feet horizontal length or body. The suction leg is twenty-six feet long, provided with a screen and butterfly valve, while the discharge leg is 27.7 feet long. The latter is provided at its bottom end with a disc valve for regulating the flow of water. The tube has a pitch of five feet in a thousand and is provided at its highest point with nozzles; one being three and one-half inches in diameter connected to a double-stage air-pump for starting the siphon, and the other, an eight-inch connection for a centrifugal pump which is used for cleaning the siphon tube and particularly the screen. Instead of using the air-pump for starting, the centrifugal pump may be called upon, in which case, both butterfly and disc valve are first closed. Fig. 1 shows the general arrangement.

Since about 180 feet of the horizontal length of the siphon is located in the lake under the normal water level, this portion of the tube, made in sections of thirty-six feet, was fitted at its ends with blank flanges and then floated to its position between piles and anchored to the framework of the piling. The final flange connections were made by divers.

SECONDARY WATER SUPPLY.

For the purpose of damming the water in the lake six sluice gates were built at the outlet of the lake, five of these gates being 13.12 feet wide and one being 6.56 feet wide. The smaller one, which is located lower than the others, is used for passing sand and gravel. Located at a right angle to the dam or sluice gates, is

FIG. 4.—GATE-HOUSE FOR PENSTOCKS, HYDROELECTRIC PLANT, BRUSIO, SWITZERLAND.

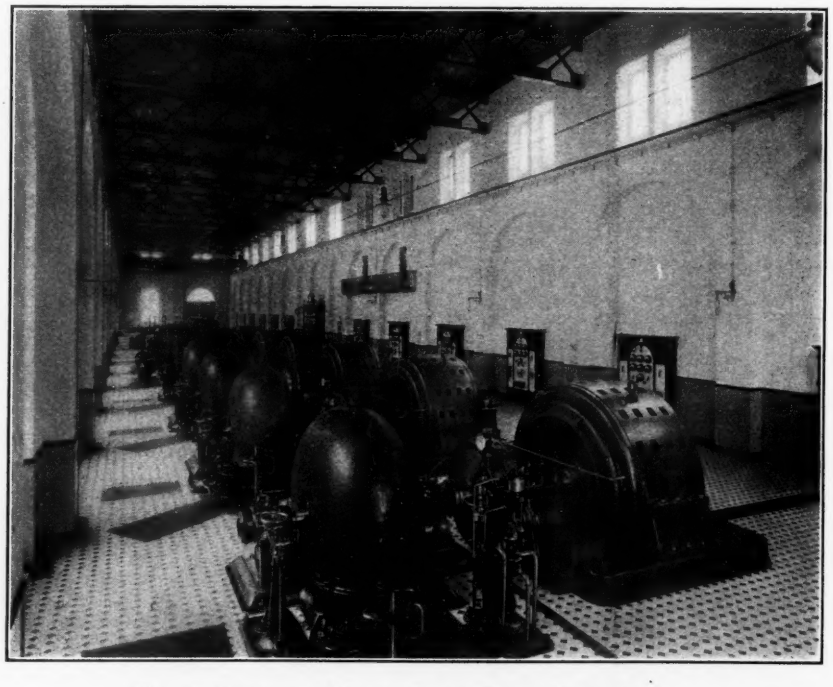


FIG. 5.—INTERIOR OF POWER PLANT, BRUSIO, SWITZERLAND.

a small basin provided with a screen. A thirty-three-inch pipe, provided with a gate, leads from this basin to the headrace tunnel, 800 feet below, where a shaft was sunk to receive the pipe; this arrangement, constituting a secondary water supply, was utilized in order to start up the plant at an early date. The size of this pipe was chosen so that it might later be used as one of the penstocks leading from the collecting basin to the power-house. This pipe by-passes the upper section of the headrace tunnel and the siphon system, furnishing the water supply during their construction pending the securing of necessary concessions.

HEADRACE.

The headrace is 17,056 feet long, 4,920 feet running through moraine (a formation similar to landslides) and the remainder through gneiss. A portion of the tunnel, near the collecting basin, lies about 100 feet deep, while the greatest portion of its length lies some 425 feet beneath the surface. With that portion of the tunnel lying at the greatest depth and running through the gneiss formation, no difficulty was experienced from seepage and air leakage, while in the portion nearest the surface, and where the tunnel runs through moraine, such difficulty was experienced. For the purpose of draining the seepage water and discharging the air, eleven lateral tunnels were cut having their outlet at the nearest point on the mountain slope.

The tunnel, where cut through the rock, was lined with concrete to a point above the water line, while the portion of the tunnel above the water was left unlined. Where the tunnel runs through the loose earth (moraine) it is constructed partly of concrete and partly of reinforced concrete, and where it was cut through the rock, pneumatic drills running on tracks were employed. For this purpose, and for lighting, a temporary power plant was installed, utilizing the fall of the Sajento River. The headrace was constructed of a wooden flume 910 feet long and a twelve-inch steel penstock. A fifty-horse-power turbo-generator, giving 4,000 volts, and the turbine also operated a two-step compressor supplying air at ninety pounds pressure through two main pipe-lines.

At three of the seepage discharge tunnels ventilators were installed during construction, while at the remainder ventilation was produced by means of branches from the compressed-air lines. Leading to the mouths of the seepage discharge tunnels Nos. 6 and 9, 1,000 to 1,500 feet above the valley, were electrical cable transportation lines.

At seepage discharge tunnel No. 2, near the lake, an overflow system is provided with a sand and gravel trap.

The entire tunnel, which is egg-shaped with a flat bottom, has a slope of two feet to the thousand and has a sectional area

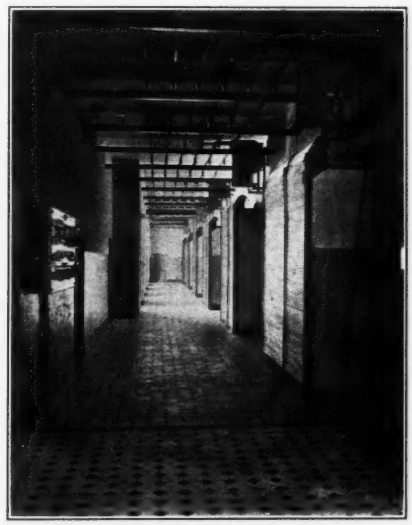


FIG. 6.—REAR OF SWITCHBOARDS AND GENERATOR BUSSES.

of fifty-three and one-half square feet. The average velocity of the water in the tunnel when partly filled is 6.5 feet per second. Should the possibility arise that in the future the tunnel should be used as

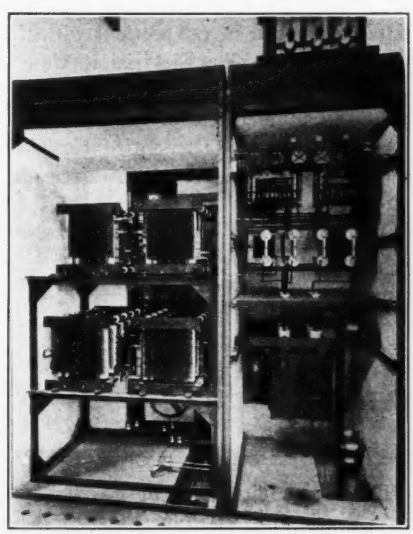


FIG. 7.—REAR VIEW OF INDIVIDUAL GENERATOR SWITCHBOARD.

a pressure tunnel, for which provision has been made, the velocity of the water will be five feet per second.

As will be noted from the dimensions of the tunnel given above, the volume of water contained in same furnishes auxiliary storage capacity to the collecting basin. Furthermore, for a length of one mile the sectional area of the tunnel was increased, and in order to properly regulate the water supply to the collecting basin, an additional overflow was provided at the seepage discharge tunnel No. 9, discharging into the above-mentioned Sajento River. The collecting basin is so dimensioned that with average loads the level of the water will be constant, while with light loads the level of the water will be higher, and during the hours of maximum load the water level will be correspondingly lower.

COLLECTING BASIN AND PENSTOCKS.

The collecting basin is located 1,300 feet above the valley and is provided with six penstock connections arranged in pairs. The connections of each pair are located in separate chambers provided with screens.

The usual practice of providing the penstocks with cutoff gates has not been followed owing to the sudden rise and fall of the water. An automatic float arrangement for signaling the attendant was installed, operating by releasing a pawl and a magnet clutch and allowing a swing gate to close.

About 100 feet from the collecting basin is a gate-house through which pass the six penstocks. At the headgates they have a diameter of 33.5 inches and, owing to the high head (1,380 feet), considerable material was saved by reducing the diameter at the power-house to 23.5 inches by telescoping certain sections of the penstocks, thus giving at its lower end a velocity of 11.5 feet per second. The penstocks are made up of rolled steel in sections 39.36 feet in length. The heaviest material employed is seven-eighths inch. The sections are bolted together by the use of movable flanges. As will be seen in Fig. 2, the penstocks run down the mountain slope at various angles, at which they are anchored in solid concrete blocks, there being ten anchorages. Between these anchorages the penstocks rest on concrete piers, the expansion being provided for by the use of slip expansion joints. At the headgates (Fig. 4) each penstock is provided with a vent pipe about forty-five feet high. Drainage gates are provided at the lower ends of the penstocks for draining into the tailrace. Here the six penstocks are interconnected by a cross pipe having two outlets, one leading to the exciters, and the other being provided with a safety device, so

that in case of excess of pressure the "bursting plate" gives way and relieves the penstocks. This cross-pipe connection also serves the purpose of maintaining a uniform circulation.

There are at present installed, corresponding to the main turbo-units, five penstocks. For hoisting the penstocks and other materials during construction, an electrically operated cable road was installed. The drum and motor are located in an annex to the gate-house near the collecting basin.

POWER-HOUSE.

The power-house (Fig. 2 and Fig. 3) is located at Campocologna alongside the River Poschiavino. The main generator room is 342 feet long by 56.4 feet wide. At the side there is a single-story switch annex 311.5 feet long by 10.75 feet wide, with a three-story central section for offices.

Owing to the topography heavy retaining walls were required, with deep and expensive building foundations. Up to the main generating-room floor the building is of concrete, while the superstructure is of quarried stone and tile. The roof construction is expensive and is as follows: Between I-beam purlins are large tile blocks, the undersides of which are glazed to form a finished ceiling. These are covered with a one-eighth-inch layer of cement over which are spread three layers of so-called wood-cement (consisting of sawdust and cement), between each of which is laid a layer of paper. Above the layers of wood-cement are reinforced concrete slabs, an air space of two and three-eighths inches being left between these slabs and the wood-cement. These precautions have been taken on account of the extreme heat in the summer time.

The building accommodates twelve turbogenerator units, each of 3,000 to 3,500 kilowatts' capacity, and four exciter units of 250 horse-power each. Ten of the turbo-generator units are at present installed. A twenty-five-ton electrically operated traveling crane serves the entire generating room.

TURBO-GENERATOR UNITS.

There are two different types of turbines installed: The Pelton wheel of Escher, Wyss & Company, of which there are at present four installed, two main and two exciter turbines, and the Girard turbine with partial admission, of Piccard, Pictet & Company, of which there are at present installed four main and two exciter turbines. The main turbines (3,000 kilowatts) run at a speed of 375 revolutions per minute and the exciters (150 kilowatts) at 430 revolutions per minute. The turbines are direct-connected to the water-wheels by flexible insulated couplings of the Zodel-Voith type.

The generators are 3,000-kilowatt, three-phase, fifty-cycle, 7,000-volt machines, and are designed for an overload capacity of twenty-five per cent. They are of the sixteen-pole, revolving field type. The poles are cast directly to the field ring. The stator is made in halves and has a bore of ten feet two inches, the width being three feet seven inches. The bedplate is made in two sections with the bearings cast on. The Elektrizitäts Gesellschaft Alioth, Münchenstein-Basel, Switzerland, manufacturers of the generators, who installed also the entire electrical equipment, guarantee the efficiencies as follows:

Power Factor, Cos $\varphi = 1$.	Cos $\varphi = 0.7$.	Load.
Per Cent.	Per Cent.	Per Cent.
93.5	92.0	0.25
95.0	93.5	0.75
96.0	94.5	1.00
96.5	95.0	1.25

The four exciters are of the six-pole, 115-volt, shunt-wound type. They develop 150 kilowatts at 430 revolutions per minute. Each exciter serves four generators with twenty-five per cent overload.

Contrary to the usual practice of centralizing the switchgear, because it was thought best for the convenience of operation and a material decrease in first cost and simplification of the wiring system, each generator has its own switchboard. As will be seen in Fig. 5, these switchboards are located against the wall next to the switchroom and directly opposite each generator.

Thus the station is divided into complete unit systems. However, to control all switchboards from one central point an instrument column has been installed as will be seen later on. The switchboards are of ornamental design and are faced with white marble slabs. All high-tension parts of the switchgear are located on the opposite side of the wall (Fig. 6 and Fig. 7) in masonry compartments fitted with corrugated-iron rolling shutters. Each generator switchboard is equipped with

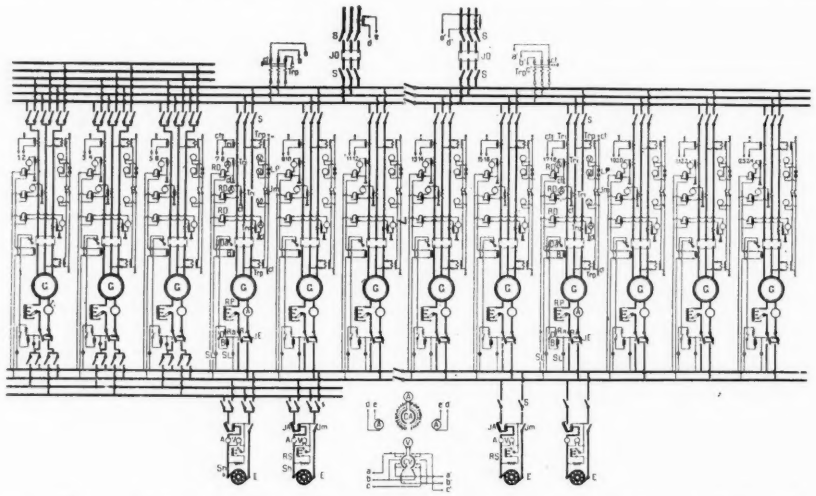


FIG. 8.—WIRING DIAGRAM OF POWER PLANT AT CAMPOCOLOGNA. A, AMMETER; B, TRIP-COIL; CA, AMMETER SWITCH; CV, VOLTMETER SWITCH; Ct, GROUND CONNECTION; Da, AUXILIARY SWITCH FOR TRIP-COIL; E, EXCITER; G, GENERATOR; JA, OVERLOAD CIRCUIT-BREAKER; JE, FIELD SWITCH WITH DISCHARGE RESISTANCE; Jm, KNIFE SWITCH; JO, OIL SWITCH; JOa, AUTOMATIC OIL SWITCH; LP, SYNCHRONIZING LAMP; Ra, RHEOSTAT; RD, RELAYS; Ri, DISCHARGE RESISTANCE FOR FIELD SWITCH; RP, SERIES RHEOSTAT; RS, SHUNT RHEOSTAT; S, DISCONNECTING SWITCH; SL, PILOT LAMP; Sh, EXCITER FIELD; Tri, CURRENT TRANSFORMER; Trp, POTENTIAL TRANSFORMER; V, VOLTMETER.

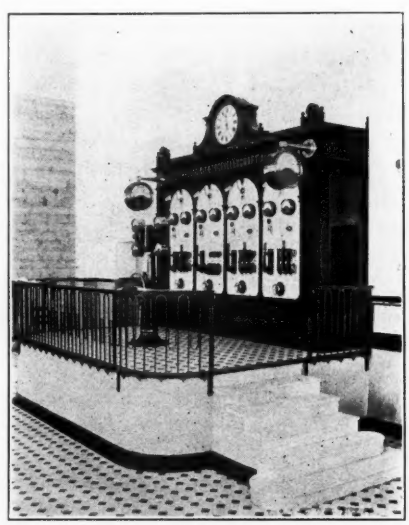


FIG. 9.—EXCITER SWITCHBOARD AND CONTROL PEDESTAL.

the following instruments: Two voltmeters; one synchroscope, with phase lamps; three ammeters, one for each phase; one three-pole oil switch, which may be operated by hand or automatically. There are, further, an ammeter on the central column, a main-current rheostat for excitation, and a field-discharge resistance.

Owing to the non-centralization of the switchgear system it was not considered necessary to install a double bus-bar or ring system so common in Swiss practice. Fig. 8 represents the wiring diagram and it will be noted that there is one main and one exciter bus-bar system. Both systems are divided in the middle by sectionalizing switches. It will be further noted that the three generators at the left, which may also be independently excited, may be thrown upon a separate bus-bar group. The current from these three generators is intended for the Valley of Brusio and for the operation of the Bernina Railway.

The outgoing feeders, with the exception of those just mentioned, are connected at the middle of the bus-bars, which are made up of copper strips two inches by three-sixteenths inch, the area of each strip being sufficient for one generator. Thus, where each generator connection joins the bus-bar an additional layer has been added. The bus-bars run the entire length of the switchroom, above the aisle and close to the ceiling. They are carried on petticoat insulators fastened to I beams and are securely anchored in the middle and at the ends, so that in case of a severe short-circuit the different phases will not be thrown together.

The exciter switchboard (Fig. 9) is located upon a platform in the middle of the generator room opposite the exciters. It is provided with four white marble panels, one for each exciter, and upon each of which are mounted a voltmeter, ammeter, knife switch, shunt rheostat and a Reversite circuit-breaker.

In front of the exciter switchboard is the above-mentioned central instrument column upon which are mounted the following instruments: An ammeter, with multiple-throw switch, to read the current of each generator; one voltmeter, with plugs, for each phase; two ammeters, one for each of the outgoing feeder-systems of the Societa Lombarda, and one hand wheel operating a shaft to which are connected the shunt rheostats of the four exciters. From this column one attendant may control the operation of the entire plant.

(To be continued.)

Illuminating Engineering Society.

The second annual convention of the Illuminating Engineering Society will be held at Philadelphia, Monday and Tuesday, October 5 and 6. The headquarters will be at the Hotel Walton, Broad and Locust streets, and the sessions will be held in the auditorium of this house.

As this meeting will take place on the first two days of the Founders' Week, when a great many out-of-town guests are expected at the hotel, it will be advisable for all members of the society to arrange for their rooms in time.

The following is the provisional programme for the meeting:

President's address, Dr. Louis Bell.

Architecture and Illumination, by Emil G. Perrot.

Modern Gas Lighting Conveniences, by T. J. Litle, Jr.

Railway Car Lighting, by H. M. Davies.

Relation Between Candle-Power, Voltage and Watts of Different Types of Incandescent Lamps, by Dr. F. E. Cady.

Illuminating Value of Petroleum Oil, by Dr. A. H. Elliott.

Structural Difficulties in Installation Work, by J. R. Strong.

Street Lighting Fixtures, Gas and Electric, by H. Thurston Owens.

Oil Burners, by W. T. Sterling.

Design of the Illumination of the New York City Carnegie Libraries, by L. B. Marks.

Intensity of Natural Illumination Throughout the Day, by L. J. Lewinson.

Calculation of Illumination by Flux of Light Method, by J. R. Cravath and V. R. Lansingh.

Specific Intensity of Lighting Sources, by J. E. Woodwell.

Design of Reflectors for Uniform Illumination, by A. A. Wohlauer.

The Ives Colorimeter in Illuminating Engineering, by Dr. H. E. Ives.

International Unit of Light, by Dr. E. P. Hyde.

Some Experiments on Reflections from Walls, Ceilings and Floors, by V. R. Lansingh and T. W. Rolph.

It is possible that some slight changes may be made in this, but such is not anticipated. The Convention Committee is planning to send each member of the society, who indicates his intention to attend the convention, advanced copies of the papers. The meeting will be then conducted by reading papers in abstract, leaving almost the entire time for discussions.

In addition to the many entertainments in celebration of Founders' Week, the Convention Committee is preparing special features for the visiting members. Further information may be obtained by addressing George Ross Green, chairman of the Convention Committee, Tenth and Chestnut streets, Philadelphia.

Electrical Utilities in Zanzibar.

The Zanzibar Railroad Company, the Zanzibar Electric Light Company, and the Zanzibar Telephone Company are three American corporations doing business in Zanzibar. The Zanzibar Railroad Company has built and is operating a line of narrow-gauge railroad from Zanzibar City to Bububu, seven miles distant. According to the Washington (D. C.) *Herald* it is proposed to extend this road the entire length of the island, which will then form one of the principal means of communication between Zanzibar City and the Island of Pemba. The railroad starts at Palace Square in the city, and after running through the Malindi district of the city and the Indian Bazaar follows the west coast of the island to its northern terminus. The trains consist of a locomotive built in Pittsburg, Pa., and two open cars and one chair car, built by the Brill Company, of Philadelphia. The chair-car fare from one end to the other is one rupee, about thirty-three cents. The fare on the open cars is considerably less. The road is well built with iron ties and good-sized rails, but the climatic conditions of Zanzibar reduce the life of an iron tie. Little grading was required for the railroad, since the highest point on the island is said to be only 300 feet above the sea level.

The Zanzibar Electric Light Company has a splendid plant. It is modern in every respect, and furnishes good light and service. The Sultan's palace, as well as the houses of the Sultan's family and retainers, is wired and lighted throughout. By means of a tower studded with incandescent lights, having an aggregate lighting capacity of 3,000 candle-power, the palace square is always brilliantly lighted. The streets are also well lighted by means of incandescent lights.

The telephone is steadily making its way into a great many business and official houses of Zanzibar, and bespeaks Zanzibar's progress in introducing modern inventions and installing all the facilities enjoyed by European and American towns of the same size.

Wireless communication was recently established between Zanzibar City and the Island of Pemba. It is said that the messages are sent in Swahili, which is the language of the natives of Zanzibar and the parent of a great many native languages of the coast.

THE TESTING OF HIGH-VOLTAGE LINE INSULATORS.[1]

BY C. E. SKINNER.

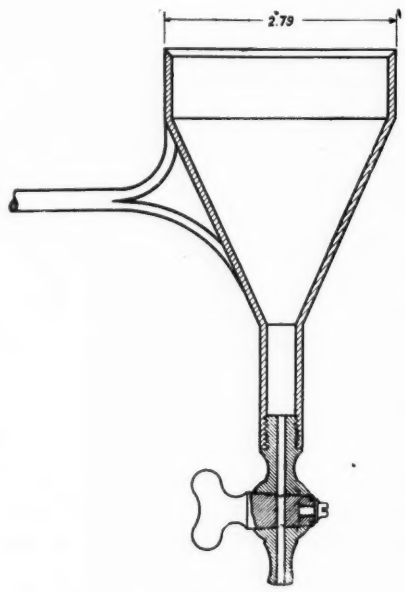
The specification herein proposed as standard for the testing of high-voltage line insulators was written at the request of the chairman of the High-Tension Transmission Committee in order to bring this matter before the Institute for discussion. It is not presented as representing the writer's personal opinion so much as an endeavor to harmonize information which he has obtained from various sources with the view of producing such a specification. Quite a large number of porcelain manufacturers and others interested in the testing and use of high-voltage porcelain line insulators in this country and in various parts of Europe have been consulted, and the information received is embodied as far as possible in the proposed specifications. It is fully appreciated that differences of opinion may exist on any point which is incorporated in such a specification. The fact that such differences do exist, and that tests are so different in different places, seems to the writer to be ample justification for the attempt at a specification which can be used by all as a standard of reference.

At the present time it is almost impossible for one familiar with a certain method of testing to base any judgment whatever as to the bearing of results obtained by some one else who uses a different method. If, after thorough discussion, and any revision which may be found essential, a specification is produced which will allow direct comparisons to be made of the performance of insulators of different types tested in various places and at different times, the object of the specification will have been in part accomplished. If a specification is evolved which can be accepted as a standard performance specification for line insulators in general, the uncertainty regarding comparisons of tests at various places and the widely varying requirements now insisted upon for conditions which are practically the same, will have been eliminated.

The specification naturally divides itself into three general parts. The requirements of routine tests are placed first, as it is considered that any tests of a routine nature which are required on insulators for the acceptance of any lot should naturally form a part of the tests made to determine the limitations of design.

The question of routine inspection for mechanical flaws and other defects is difficult to outline definitely, as a complete description of all points which might constitute cause for rejection would make the specification unduly long and complicated, and it is therefore usually considered better to leave this to the judgment of the inspector.

Some difference of opinion has been expressed as to whether the dielectric test on each individual part of insulators made up of parts should be included in the routine test instead of in the design test. It is the writer's understanding that such tests are invariably made by the porcelain manufacturers for their own information, whether specified as a part of the routine test or not, and it would therefore seem that there should be no very great objection to their being included in the routine test.



SPECIAL RAIN GAUGE.

It is possible that in some designs the voltage tests specified can not be met by certain shells which are used next to the pin for the purpose of increasing the dielectric strength when the other parts of the insulator are wet, due to the short surface distance. If the surface distance on the short shell is so small that this test can not be reached, it is probable that the object of inserting the short shell is in some measure defeated in the particular design. It might be possible to substitute a fixed test for each individual part of a shell independent of the voltage on which the insulator is to be used, as it is difficult if not impossible to get porcelain to stand tests of above 60,000 to 70,000 volts, regardless of the thickness. The better material in the thinner shells gives results equal to the poorer material in the thicker shells, due to shrinkage cracks and other defects which it is ordinarily impossible to eliminate in thick porcelain. The provision to exclude insulators which show excessive local heating is inserted for the reason that those familiar with such tests may at times be perfectly sure that an insulator is unsatisfactory even though it is not punctured. The term "localized discharge" as used does not mean the discharge which occurs uniformly around the insulator at the point of contact, but a discharge at some point on the surface; such discharge sometimes indicating a spongy material which will eventually give trouble.

Under design tests the amount of pull to be applied to the insulators is not specified for the reason that the strength must necessarily depend on the particular design, and the figures to be inserted, of course, should be agreed upon in each case between the manufacturer and the user.

The rate of precipitation specified in the rain test is probably greater than will ever be experienced except in very excessive storms, and even then only for a very limited time. The rate specified is less than that used as standard in some parts of Europe. A fairly wide limit of variation in rate is allowed, partly on account of the great difficulty in securing a perfectly definite and uniform rate, and partly from the belief—borne out by rather limited tests—that little difference in the results of tests will be obtained between the limits specified. It is desirable in the discussion of this paper that as much information as possible be brought out relative to the best possible method of obtaining a satisfactory spray.

The requirement that the insulator shall be tested with the pin at an angle rather than to attempt an angular rainfall is given for the reason that a satisfactory method has not yet come to the writer's attention for the obtaining and maintaining of a satisfactory angular rainfall, under the conditions which usually obtain where insulators are to be tested. It is far easier to incline the insulator and use a vertical precipitation, and it is considered far more probable that results can be repeated than by providing for an inclined precipitation.

The use of a rain gauge for determining the rate of precipitation is specified, as the writer has found it nearly impossible to get the rate of precipitation by measuring the flow of water through the supply pipe, which is frequently done. The diameter is limited to three inches for the

[1] A paper presented at the annual convention of the American Institute of Electrical Engineers, Atlantic City, N. J., June 30, 1908.

reason that a larger gauge would disturb the distribution of the spray to some extent. The type of rain gauge illustrated herewith is suggested as convenient and as having been found satisfactory in tests where it has been used. The diameter of the funnel is so chosen that the precipitation for any elapsed time measured in cubic centimetres and divided by 100, gives the rate of precipitation in inches for that elapsed time. By means of the valve at the bottom the water may be run into a standard chemical burette, and quite accurate measurements made. In use the rain gauge is inserted upside down into the spray, and then quickly turned to the upright position when the location to be measured is reached. A suitable card or other covering is then quickly placed over the top at the end of the elapsed time. It would, of course, be easy to provide a lid which could be opened and closed, in place of the method specified.

The writer would lay special emphasis on the importance of the dew test as probably determining the most severe condition which the insulator will ever be called upon to meet in practice. Also the fact that such a test is more nearly capable of exact repetition than any precipitation test. Furthermore, in such a test the moisture on the surface of the insulator must be perfectly clean water if the insulator itself is clean, and therefore is more like natural rainwater and eliminates any possibility of variations due to the quality of the water used.

PROPOSED STANDARD SPECIFICATIONS FOR THE TESTING OF HIGH-VOLTAGE LINE INSULATORS.

General—This specification is intended to provide a standard method of making tests on porcelain insulators or their equivalent which may be designed for use on transmission systems of 6,000 volts or above. The specification is intended to provide a means of determining the performance of any insulator, and is not intended to restrict design in any way whatsoever. The specification is divided into three parts as follows:

1. Routine tests, or tests to be made on each individual insulator, to show whether or not workmanship, materials and dielectric strength are up to the required standard.

2. Design tests, or tests to show the limitations of a design under a specific set of test conditions.

3. Methods of Testing—The methods to be followed in making the various tests specified, are separated from the body of the specification as a matter of convenience for reference.

1. ROUTINE TESTS.

a. Inspection—Each insulator shall be inspected to see that it is reasonably free from mechanical flaws, defects of glazing and cementing, chipping, etc. Those parts of the insulator which are to be fitted to caps, pins or other fastening devices shall be sufficiently close to design dimensions to insure first-class work in assembling and mounting. The general over-all dimensions shall not vary more than plus or minus five per cent from the designed size.

b. Dielectric Tests—When tested dry each shell of insulators of the cemented type and each unit of insulators made up of units, shall withstand for a period of five minutes three times its proportion of the line voltage, based on the total number of shells or units of which the insulator is composed. (For example, each shell of a four-part insulator shall withstand three-fourths times the normal line voltage on which the insulator is to be used, for a period of five minutes.)

When tested dry each completed insulator shall withstand for a period of five minutes 2.5 times the line voltage on which it is to be used.

If any shell of any insulator shows excessive localized discharge without puncture, the test on same may be continued for two additional periods of five minutes each. Excessive local heating or excessive localized discharge shall, if continued, be considered a failure.

Insulators not to exceed five per cent of any lot shall be tested for flashover by raising the voltage gradually, or by steps of not more than five per cent, until flashover occurs. If there is failure by puncture of more than one-half of those so tested, the flashover test may be required on all insulators of the lot on order.

2. DESIGN TESTS.

Tests to determine the limitations of any particular design are to be made on a few insulators, not more than five per cent of any particular lot on order.

a. Mechanical Tests — Insulators mounted on pins shall withstand a side pull exerted on the tie groove at right angles to the axis of the pin, of .... pounds. Cemented insulators and insulators made up of units shall withstand a direct pull along the axis of the pin, or equivalent, of .... pounds, the force being exerted between the cross-arm and the line fastenings.

b. Routine Tests—Insulators must successfully withstand tests under the heading of routine tests.

c. Rain Tests—In addition to the routine dielectric tests, the insulators shall withstand the following dielectric test when subjected to artificial rain. With a vertical precipitation of not less than 0.3 inch per minute, and not more than 0.4 inch per minute, the insulator in normal position mounted on a crossarm or its equivalent, with pin with which it is to be used, the complete insulator shall withstand for five minutes 1.5 times the normal voltage of the line on which it is to be used. With the same rate of precipitation and with the cross-arm so turned that both the cross-arm and the insulator pin are at an angle of forty-five degrees to the vertical, the complete insulator shall withstand for five minutes 1.25 times the normal voltage of the line on which it is to be used.

d. Dew Test—With the insulator cooled to zero centigrade, or below, and then placed in a moist atmosphere of thirty degrees to forty degrees centigrade, it shall withstand 1.25 times the normal line voltage after the insulator has become thoroughly covered over its entire surface by the condensation of moisture from the atmosphere.

3. METHODS OF MAKING TESTS.

a. Mechanical Test—The strength test of the insulator may be made by any suitable means of obtaining the specified pull. For this test pin insulators should be mounted on the pin with which they are to be used in practice, and a heavy copper wire or cable looped in the tie groove in such a way that there will be no injury exceeding that which would occur from the application of the standing tie. Insulators of other types shall be tested by having the pull exerted between the mounting intended for the crossarm and the line wire.

b. Dielectric Tests—Dry Test—The surface of the insulator shall be clean. The test on pin type insulators shall be made by placing the insulator upside down in a pan of water to a depth just sufficient to cover the tie groove or equivalent. This pan with water forming one testing terminal should be as small in diameter as possible and so arranged that the striking distance over the surface of the insulator is not reduced. Water shall be placed in the pin hole of the insulator, covering that portion of the insulator which would come in contact with the pin or equivalent. When insulators have metal thimbles placed in the pin hole or are mounted complete with metal pins, the thimbles or pins may be used in place of the water in the pin hole. Connection to the water in the pin hole forming the other testing

terminal shall be made by means of any suitable metallic conductor, which must be so placed that it is central with the pin hole and extends far enough above the insulator so that it will not shorten the striking distance from the wire groove to this conductor. In testing the shells of insulators made up of concentric shells, tests shall be made from a pan of water in which the insulator is placed upside down as one terminal, to water placed inside the shell as the other terminal, the depth of water in the pan and in the shell being so arranged as to cover that part of the insulator which will be in contact with the cementing material. In testing units of insulators made up of units, the testing terminals shall consist of the metal mountings or their equivalent, with which the insulators are to be used in practice.

Rain Test—The rain test shall be made by mounting the insulator on a metal pin or equivalent, so arranged that it may be placed either vertically or at an angle of forty-five degrees to the vertical. Clean water shall be used and the precipitation shall be such that the water falls in a fine spray and in practically a vertical direction and at a rate of from 0.2 inch to 0.3 inch per minute, over the area formed by the vertical projection of the insulator. The rate of precipitation shall be obtained by the use of a suitable rain gauge of not more than three inches in diameter.

Frequencies—Dielectric tests shall be made at the standard frequencies of either twenty-five or sixty cycles per second. Any frequency between twenty-five and sixty cycles will be considered as meeting the specification. Lower or higher frequencies will be considered as special.

Voltage Control—When only a very limited number of insulators are tested in parallel, the test voltage may be taken from a constant-potential source and applied directly or it may be raised to the required value gradually. When a considerable number of insulators are tested together, the test voltage shall be raised to the required value smoothly and without sudden large increments and then applied for the prescribed interval. Flash-over tests and other tests requiring variation of voltage shall be made by raising the voltage to the required value smoothly and without sudden large increments.

Illumination of a Large Office.

Office lighting is rightly regarded as one of the difficult problems in illumination. Bookkeeping requires close application and demands such constant service of the eyes that office men are notoriously sensitive to the lighting conditions. Especially is this true in a large office where many employés are grouped together. Architects are giving more and more thought to the provision of suitable day illumination, while the demand for improvement in artificial illumination is even more imperative.

Daylight Photograph of the Office of the Stanley Works, New Britain, Ct.

The simplest and most common method of office lighting is to provide small individual units in the form of desk or drop lights. In many cases this is the best available form of illumination, especially when the working illumination is required only at isolated points. Perhaps the most serious fault to which this method of illumination is commonly subject is the glare of the lamps themselves or of the light reflected from desks or papers.

It is not unusual on entering an office

to find the fixtures draped with all kinds of shades and provided with the highest power lamps obtainable. This is an indication of unsatisfactory illumination. Unfortunately instead of improving the illumination the experiments generally result in increased glare and consequently increased eye-strain.

A more modern office lighting is by general illumination, produced by larger units installed near the ceiling and so arranged as to give even illumination. Where work is sufficiently concentrated this method of illumination is cheaper to install and operate. A fine appearing installation can be produced, which will not clutter up the room and will not suggest interference on the part of the employés.

In making such an installation it is advisable to use considerable care in selecting the unit so as to produce a satisfactory result. The light source should be of low intrinsic brilliancy, with a relatively large diffusing surface in order to avoid glare, and dense contrasting shadows. The lamp should be economical to operate, and should distribute the light so as to produce an approximately even intensity of illumination in all parts of the room.

The capacity of the unit should be as large as possible, consistent with an even distribution. In a large room with a high ceiling a relatively large unit may be used. A number of different arc and incandescent lamp combinations are available for this class of lighting. The equipment most suitable for a particular case frequently depends upon local conditions.

A representative installation in which an excellent illumination is produced by means of the ceiling diffuser arc lighting system is in the offices of the Stanley Works, manufacturers of builders' hardware, at New Britain, Ct. This company completed a new office building in the late summer of 1907. The artificial lighting of the large general office was planned by the illuminating engineering department of the General Electric Company in cooperation with the architects and the purchasing department of the Stanley Works.

The room in question has a twenty-two-foot stud. The working area is eighty-two feet by seventy-five feet and is lighted by means of twenty-four six-ampere, direct-current enclosed arc lamps, with the recessed type of ceiling diffusers, consuming 15.8 kilowatts.

The lighting has been in service throughout the dark winter months and has given entire satisfaction to both the company and the employés. The excellent illumination of the office, both by daylight and artificial light, is illustrated by the accompanying photographs, which were made under the regular lighting conditions, without flash light or any special treatment.

NIGHT PHOTOGRAPH OF OFFICE OF STANLEY WORKS, NEW BRITAIN, CT., ILLUMINATED WITH CEILING DIFFUSERS.

New Ohio Law Is Valid.

The Ohio state initiative and referendum law has been held constitutional by Judge Chapman in the Common Pleas Court. The test case will be carried to the state Supreme Court, however, for a final decision. The suit was brought after an effort was made to have a vote taken on the franchise granted by the Cleveland city council to the Municipal Traction Company. An election has been ordered by the city council. The law was passed by the legislature last winter.

Electrical Notes from Great Britain.

(From Our British Correspondent.)

IN April last a fire occurred in one of the carriages of an electric train on the Liverpool-Southport Railway just after departure from the Freshfield station. A. P. Trotter, the electrical adviser to the board of trade, has just issued a full report on the occurrence. He divides the cause of the primary fire into two considerations: (1) A short-circuit from a positive cable to the underframe of the carriage; (2) the persistence of the current after it had been automatically cut off. The latter he regards as serious. It was impossible to ascertain the exact nature of the defect which resulted in the short-circuit. Mr. Trotter makes the suggestion that in the construction of new rolling stock, greater care be exercised in protecting cables against the weather so that short-circuits due to water or snow may be avoided. To prevent the persistence of the current, he recommends that each section should have its own feeders, circuit-breakers, etc.

T. O. Callender on July 14 told a sorry tale concerning the variety of unforeseen difficulties that have arisen during the last few years to hinder the progress of the Lancashire Electric Power Company. The generating station, which has a supply capacity of 12,000 horse-power, is at present drawn on only to the tune of 4,000 horse-power, and a considerable part of this is being at present supplied at a loss financially, because there was no practical data available to guide as to correct price for this particular consumer, and the experience has had to be bought. When this contract expires, as it will do in a year, it will be renewed at a higher figure, the consumer having agreed to that course rather than be without the company's supply. Difficulties attending negotiations with municipal authorities in its area for permission to supply energy, have involved heavy expense and serious delays. Another obstacle to electrical installation progress has been the great boom in the textile trades of Lancashire during several years past. Mill owners have expressed themselves as altogether opposed to stopping their works or slackening their operations for the introduction of electrical driving, a good and necessary improvement as they admitted it to be, while there was so great a demand for their manufactures. Now, however, their trade has become slack, and they are beginning to do what they could not undertake when times were so good. Already the Lancashire Power Company is feeling the benefit, and this fact, together with the present improved relations with municipal authorities, points to a better state of things. The development of the business is now in the hands of the Lancashire Power Construction Company, and Horace F. Parshall has, after special invitation, taken the helm as chairman at $5,000 per annum plus ten per cent on the profits in excess of $100,000 per annum before debenture interest is paid.

For many years past the Institution of Electrical Engineers has occupied other people's premises both for general office and library accommodation, and for halls in which to hold its meetings. It is true that at the Victoria street office there is a room sufficiently large for students' meetings and for some gatherings of the Faraday Society, but for anything larger than these, other engineering societies have lent their halls—chiefly the Institution of Civil Engineers. It has been pretty generally felt for a long while that this was a most undesirable position for so important a body of professional men representative of so progressive a department of engineering science and practice, and in consequence a building fund has been accumulating for years. Many a time expression has been given to the desire that all of the great engineering societies might come together to consider a scheme for a large central engineering building in which all could be housed, but the idea has received little encouragement from those most in a position to help toward its fulfilment. The Institution of Electrical Engineers has now, therefore, with pretty general approval from its members, purchased a lease of seventy-six years of what is described as a very suitable building, or one costing comparatively little to make it adaptable to the needs of the Institution. It is situated on the Victoria Embankment and is known as the Medical Examination Hall. The capital cost is £50,000, plus £6,000 for alterations to theatre, furnishings, etc.

The new premises will not be ready for occupation for a year. It is hoped that part of the expenses will be met by letting portions of the building to other societies. The need that electrical men feel for a meeting place in London at which they can hold intercourse with one another at any time—not merely when the announced meetings are in progress—will be met by the foregoing scheme.

Surface contact tramway traction has had most unfortunate experience in England. We announced some time ago that the London County Council was putting down an experimental section of line to be operated on the "G. B." (Griffiths-Bedell) system in Bow and Aldgate, in the East End. It was hoped that after the practical experience with the system in successful running at Lincoln, it would be possible to provide some parts of London with a service which should cost less to construct and equip than the conduit tramway, and should be free from all the alleged objectionable features of the trolley. This hope, according to the latest information, is not to be realized, for defects which have appeared in the running of the Aldgate cars led to the withdrawal of the latter from service on July 17. It is reported in some quarters that this will probably mean the taking out of the system, and if this turns out to be correct it can hardly fail to be fatal to any extension of surface-contact working in this country, especially coming as it does on the heels of the supersession of the Dolter system at Mexborough by the overhead trolley. The chief trouble at Aldgate seems to have been due to live studs, a defect which has to be avoided at all costs in thoroughfares carrying heavy traffic of all kinds.

The Tramways and Light Railways Association held its annual congress on July 9 and 10 at the Franco-British Exhibition at Shepherd's Bush. The Duke of Argyll welcomed the members and Sir Clifton Robinson, who not long since returned from a tour of inspection of tramways in different parts of the world, gave a lecture on "Tramways of the World." He reviewed the course of events in street-tramcar practice since Train put down his first tramway at Birkenhead in 1860. He thought that British tramways if skilfully managed and conservatively financed ought to have an indefinite period of financial prosperity. This should be cheerful news for electric tramway investors who are reaping anything but an adequate return on their investments at the present time. He set down the fol-

lowing directions in which British tramways are handicapped as compared to other countries: (1) British cars are not permitted to travel fast enough, the average speed being less than ten miles an hour. (2) Our double-deck cars, in general use, cause much delay, particularly at stopping points. This type of car was adopted in order to comply with regulations. (3) Traffic could be handled more successfully on special occasions were the present licensing restrictions regarding passengers removed or amended. Speaking of foreign countries he said that the main obstacle to greater development in eastern cities was the narrowness of the streets—this was particularly noticeable in Tokio, Japan, which city has a network of electric tramways, either in operation or proposed. Wherein British tramways lagged behind other countries, it was not the fault of capitalists or engineers, or business men—legislative restrictions and innate conservatism were the real troubles; but we in England had profited by the experience and mistakes of other countries in the matter of efficient apparatus and plant. Sir Clifton Robinson has had to do with the promotion and engineering of a number of important English trolley lines and he has come to close grips with the manifold problems and difficulties, and his views are those of one who has had exceptional opportunities to study the subject—especially from the private company point of view. Alfred H. Gibbings followed with a paper describing modern forms of tramway rail-joints, and the methods which were now being employed to make the joint in operation as nearly as possible like the rest of the rail. A lecture on "Rail Corrugation," delivered by C. A. Carus Wilson, was the other feature of particular interest at the congress.

There is now proceeding at Olympia an exhibition of mining machinery. It contains many specimens of typical English electrical machinery and apparatus for application in mines, electrically driven equipments being present in all parts of the building. The exhibition is timely in view of the great development that is now taking place in colliery equipment. The Franco-British Machinery Hall, with its electrical exhibit, is now in a complete condition. Arrangements are now being pushed forward rapidly for the electrical exhibition which opens at Manchester about two months hence.

ALBERT H. BRIDGE.

London, July 25.

FUNDAMENTAL CONSIDERATIONS GOVERNING THE DESIGN OF TRANSMISSION-LINE STRUCTURES.[1]

BY D. R. SCHOLES.

Before the work of designing a tower or pole for a given transmission line can proceed, a statement must be made setting forth the loads which the structure should be capable of withstanding. This statement is, in general, based on a forecast of the probable extreme weather conditions which may occur in the vicinity of the line, and also on a prediction as to what accidents will probably occur to the conductors of the line.

There are naturally considerable variations in forecasts of this sort and these variations are due primarily to a lack of accurate data regarding the various factors which enter into the case. The cost of a line is affected very largely by the figures which are selected to represent the probable extreme conditions, and the selection and application of these figures are therefore matters of a great deal of importance. Unfortunately, data on this subject are very meagre, and a rational solution of a problem involving weather conditions and possible accidents is manifestly impracticable. It seems, therefore, that the best guide in selecting figures to represent the probable extreme load conditions is experience with existing transmission-line structures and other structures similar to them.

During the last few years many members of the Institute have had occasion to investigate this subject, in preparing specifications for transmission lines. A discussion referring to experience with these lines and bringing out the ideas of each as to what load conditions should be provided for would be very beneficial. It is hoped that there will be such a discussion following this paper.

Figures must, in general, be selected to represent the forces which may come upon a transmission-line structure as a result of one or more of the following influences:

Wind.

Sleet.

Low temperature.

Accidents, as breaking of cables, etc.

It is also necessary to select a factor or factors of safety for use in connection with these figures, and a prediction must be made as to whether or not loads resulting from two or more of these causes are likely to occur at the same time. Considerations of cost often determine to what extent provision shall be made, in a given line, against such combinations of extreme conditions. In a very important line it may properly be considered desirable to provide strength against a combination of conditions likely to occur only once in a hundred years, whereas in a less important line the possibility of such a chance condition might, with equal propriety, be neglected.

Wind Pressure on Structures—The records of the Weather Bureau are available as an aid in estimating the maximum wind velocity to be expected in a given locality. The relation between wind velocity, however, as indicated by a government anemometer, and the actual pressure in pounds per square foot produced by a wind of that velocity on a cable or on the members of a tower, is by no means definitely known. In fact this relation is so uncertain that the most one can hope to gain from an examination of the weather reports is a general idea as to whether the winds occurring in a given locality are likely to be high or not. The anemometers of the Weather Bureau do not take account of sudden gusts of wind. The published velocities are not accurate, but must be corrected according to a correction table which may be obtained from the Weather Bureau.

The relation between wind velocity and the pressure produced by the wind on a plane surface normal to the direction of the wind is given by the formula,

$M = K V^2$, where

M = pressure in pounds per square foot,

V = wind velocity in miles per hour, and

K = constant.

Experiments in general indicate that the form of this equation is correct, but experiments differ as to the proper value of K. The values given range from 0.0035 to 0.0048. According to tests by the Weather Bureau, K = 0.004, which is probably the most reliable figure there is for K.

Experiments indicate that, in general, higher pressures are to be expected at the top of a tower than near the ground, but little is known as to how the pressure is distributed. There is considerable doubt as to what should properly be considered the exposed area of a structure; it is certain, however, that both faces are not, in general, subject to the same pressure. It is usually considered that a reduction factor of 0.5 should be used in figuring the wind pressure per square foot of projected area of cylindrical surfaces. The wide

[1] A paper presented at the Annual Convention of the American Institute of Electrical Engineers, Atlantic City, N. J., June 30.

use which has been given this factor is its principal recommendation.

The purpose of the foregoing remarks on wind pressure is to point out some of the reasons for uncertainty in wind-pressure calculations. In view of these uncertainties it seems necessary to turn to some empirical method for providing against loads due to wind pressure. In bridge work pressures of from thirty to fifty pounds per square foot are commonly assumed, and these pressures are used in connection with factors of safety of from four to six. Structures built to withstand loads calculated in this way are found to be strong enough. How much too strong they are is a matter of conjecture. The usual transmission line can not stand the expense of structures built to bridge specifications. Experience with bridges can not, therefore, be of much help in the present connection.

Steel windmill towers have been in general use for about eighteen years. Such towers are built to withstand wind loads almost exclusively and their use is very widespread. It is known that the provision against wind loads in these structures is not excessive, for there are occasional failures. The windmill tower is, in general, similar to the towers used in transmission lines. The success of a given design of windmill tower depends on what might be called the integrated experience of all the users of towers of such design. Competition has led builders to reduce their weight to a minimum. It is probable, therefore, that a windmill tower of standard design which is widely used has just about enough strength to resist the highest winds, tornadoes excepted, and it would appear that a study of such a windmill tower will probably give the best data available for use in connection with transmission-line structures.

An examination of a standard design of windmill tower, of which many thousands are in use, shows that such tower will actually fail under loads calculated on the basis of wind pressures of from forty to fifty pounds per square foot. The tower referred to is of square pyramidal form, and in the calculations it is assumed that the wind is blowing at right angles to one side, and both faces of the tower are considered equally exposed.

It appears, therefore, that it would be good practice in transmission-line construction to specify that the poles or towers should, in addition to their other properties, have strength to resist loads on their members due to a wind pressure of forty pounds per square foot, with a factor of safety of from 1.5 to two, based on actual test. Such a structure would be suitable for locations where the winds are high; in other locations these figures would be reduced by judgment, aided by a consultation of the weather reports and other such data.

Factor of Safety—A few remarks regarding factor of safety may be proper at this point. The factor of safety used in connection with the design of a given piece of engineering apparatus, is, in a sense, a measure of the uncertainty attending the making of calculations of the loads to be sustained or of the strength of the structure under consideration. In designing a complicated structure to sustain a complex system of loads it would be natural and proper to allow a large factor of safety, particularly if the structure were such that it could not be tested to destruction to check all calculations and methods. On the other hand, a smaller factor of safety would be equally safe in connection with a simple structure to sustain certain definite loads, the actual ultimate strength of the structure having been determined by testing it to destruction.

The structures ordinarily used in transmission lines are simple. They are usually built in large numbers from standard designs. It is proper, therefore, that the design for such a structure should be carefully investigated and that specimen structures should be tested in such a way as to remove all doubt as to their ability to withstand the loads for which they are intended. And, notwithstanding the fact that calculations of wind pressure are uncertain, experience with windmill towers removes, to a large extent, the uncertainty which would otherwise surround the figure forty pounds per square foot which has been suggested.

Wind Pressure on Cables—The opinion is commonly held that, in providing against wind pressure on a surface such as that of a long span transmission-line cable, it is not necessary to allow for as high a pressure as is necessary for a surface extending through smaller linear distances. Data on this subject are, as yet, very indefinite, and there is great need of specific figures for the pressure experienced on the cables of a transmission line. The following experiment is suggested as a means of securing such data:

The experimental apparatus would consist of a typical transmission-line span of from 500 to 1,000 feet, erected as near as possible to a Weather Bureau station. The cable would be fixed to the tower at one end and would pass over a pulley at its other end and be secured to a weight, this weight serving to maintain a uniform tension in the cable at all times. The position of the weight would be recorded at all times by means of a pencil and moving drum. Continuous records of temperature and wind velocity are made in the Weather Bureau stations. An analysis of the three records, namely, those of temperature, wind velocity and the length of the cable in the span, would give data from which the wind pressure in pounds per square foot of projected area of the cable could be calculated. It would also be desirable to have a continuous record of the direction of wind, and this record could be readily obtained.

Records from such apparatus extending over a period of a year or more would be of much interest. It is to be observed that the readings would furnish a means of checking the coefficient of expansion of the cable. Data obtained in this way would have direct relation with the Weather Bureau reports, and most questions as to methods of calculation of pressure on conductors would thus be eliminated.

In the absence of specific data relating to wind pressures on the cables of long spans, it seems unsafe to assume a pressure of less than thirty pounds per square foot for localities where the winds are known to be high. The figure thirty pounds per square foot is commonly used in bridge calculations for surfaces extending through horizontal distances of sixty feet or more. It seems that a factor of safety of two should be used in connection with this pressure, so that the conductor will not be stressed beyond its elastic limit, under extreme conditions.

Sleet—Destructive sleet storms occur in the eastern part of the United States at least as far south as Atlanta. During the past winter a sleet storm occurred in the region of Chicago after which a coating of ice over half an inch thick was observed on conductors of various sizes. In many cases the thickness of ice at the centre of the span was much greater than at the insulators, due to the tendency of the water in the sleet to run down to the lowest point while freezing. The sleet formed during this storm was practically solid ice, and it remained on the conductors for several days. In view of observations made after this storm, it is the writer's opinion that, for localities where sleet is known to form, provision should be made against a coating of ice on the cables at least one-half inch thick,

in combination with a factor of safety of not less than two based on the ultimate strength of the conductor.

There is much discussion as to whether the safety of a line demands that provision be made against sleet, low temperature, and high wind all occurring at the same time. If the sleet forms at all, it is certainly possible that it will remain on the wires several days. And if it remains on the wires several days it is certainly entirely within the range of possibility that high wind or low temperature, or both, will occur before it melts off. Whether or not provision should be made against a combination of these three extreme conditions becomes, therefore, entirely a question of how much the owners of the line are willing to pay for immunity from interruptions of service due to these causes. These are matters to be settled between the engineer and the owner of the line.

Accidents, as Breaking of Wires, Etc.—In providing mechanical strength in the line to resist loads due to accidents to the cables, there are two well-known plans which may be followed. In the one all structures are given the same strength, each having strength to withstand the loads due to accidents which it is contemplated may occur in any span; in the other plan, two kinds of structures are used—a standard structure intended to support loads transverse to the line only, and a heavy structure having strength against the breaking strength of all the cables. These heavy structures are distributed along the line at intervals of a mile or so. The first-mentioned type of construction is best adapted for lines having relatively small conductors, while the second type is favorable where the conductors are heavy.

In designing a line of the first-mentioned type it is usual to assume that any two conductors may break in a given span due to the formation of an arc between them, and that the tower or pole should be capable of withstanding the loads so developed without damage to itself. Provision is not, in general, made for the simultaneous occurrence of such breakage and high wind or sleet. It would seem, however, that in such cases the towers might be better designed to withstand wind loads transverse to the line in addition to the loads due to the breakage of any two conductors, since arcing is more likely to occur in a high wind than at other times.

It is believed that the factor of safety used in connection with the loads due to breakage of conductors should be greater in the case of suspension type insulators than with pin insulators. When a conductor supported by suspension insulators breaks, it will suddenly move away from the point of breakage and will be brought to a sudden stop when the insulator comes into line with the cable. The movement will occur, in decreasing amount, all along the line or until the strain insulator is reached. This sudden application of load and the attending inertia effect will subject the cross-arm to a greater force than the tension which existed in the cable before it broke. It is suggested that cross-arms be tested to loads equal to 1.25 times the elastic limit of the conductor for pin insulators and 1.5 times the elastic limit of the conductor for suspension insulators.

Foundations—It is a usual assumption that the resistance to uplift offered by a foundation is equal to the weight of the foundation plus the weight of earth contained in the frustum indicated in Fig. 1, the angle of inclination of the sides of the frustum being thirty degrees. The results obtained by this method agree quite closely with practice in anchors for windmill towers. In addition to resisting uplift, the foundation must, in general, have strength against horizontal forces at the ground line. The variety of designs of foundations is so great as to make a discussion of them impossible within the limits of this paper. It is suggested that, in developing the design of a foundation for a given line, tests should be made to determine the holding power, density, etc., of the soil of the locality so that the strength of the foundation will be known as accurately as the strengths of the other parts of the line.

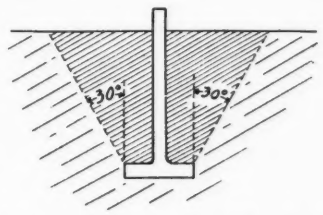


FIG. 1.—GRAPHICAL DIAGRAM OF FOUNDATION RESISTANCE TO UPLIFT.

Copper Production in 1907.

The Department of the Interior, United States Geological Survey, has issued an advance statement of the country's production of copper in 1907. The output is given as 868,996,491 pounds. This is a decrease of 48,809,491 pounds, or 5.6 per cent, from the record figures of 1906, the largest actual decrease ever recorded and the largest relative decrease since the American copper industry became important. This is the first time since 1901 that the annual production has been smaller than that of the preceding year and the first time since 1872 that it has been smaller than that of the second preceding year.

In the following table the copper production for 1907 is apportioned to the states in which the copper was mined. The total is made up of the fine copper content of blister produced and of the smelter output of ingot and anode copper from Michigan. The production for 1906 is given for comparison:

	1907.	1906.
Alaska	7,034,763	8,685,646
Arizona	256,778,437	262,566,103
California	33,696,602	28,153,202
Colorado	13,998,496	7,427,253
Georgia	.....	17,182
Idaho	9,707,299	8,578,046
Massachusetts	.....	9,744
Michigan	219,131,503	229,695,730
Missouri	.....	54,347
Montana	224,263,789	294,701,252
Nevada	1,998,164	1,090,635
New Mexico	10,140,140	7,099,842
North Carolina	544,040	582,209
Oregon	518,694	545,859
Tennessee	19,475,119	17,809,442
Texas	.....	51,377
Utah	66,418,370	50,329,119
Vermont	696,102	11,694
Virginia	57,008	.....
Washington	122,263	290,823
Wyoming	3,026,004	106,177
Alabama, Georgia and Maryland	90,655	.....
Missouri and unapportioned	1,299,043	.....
Total	868,996,491	917,805,682

Of this quantity, approximately 10,075,048 pounds in blister were produced in foreign smelters from domestic materials exported. In addition to the domestic materials handled, smelters in this country turned out as blister 64,145,648 pounds from foreign ore, concentrates, and matte. Domestic blister containing 42,350,963 pounds was exported unrefined, while blister from foreign sources containing approximately 183,530,132 pounds fine copper was imported for refining in this country.

The production in 1907 of refined new copper of domestic origin was 784,271,427 pounds, a decrease of 103,410,960 pounds, or 13.2 per cent, from the production of 1906. The total output of refined copper (exclusive of domestic scrap, etc.) by domestic refineries in 1907 was 1,032,516,247 pounds.

Returns from all the Lake and electrolytic refineries are practically complete and show that the following stocks of refined copper were on hand at the beginning and end of the year:

	Pounds.
January 1, 1908	125,745,796
January 1, 1907	46,497,181
Stocks increased during 1907	79,248,615

Undelivered sales are almost entirely excluded from these figures. Stocks carried by consumers and brokers have not been estimated. In addition to these stocks of refined copper, there were at smelters, in transit to the refineries, and at the refineries blister copper and material in process of refining to the amount of 135,310,239 pounds on January 1, 1907, and of 175,254,659 pounds on January 1, 1908.

The apparent consumption of refined new copper in the United States in 1907 was about 485,000,000 pounds, as compared with about 685,000,000 pounds in 1906. One method of deriving these figures is based on the total refinery output.

American Electrochemical Society.

At a recent meeting of the board of directors of the American Electrochemical Society the previous action of the board in regard to the new class of subscribers, to be called "junior associates," was amended to read as follows: "Students in high schools, technical schools, colleges or universities, or assistants in technical laboratories, furnishing references of good character from their professors or employers, subject to the approval of the board of directors, may, by the payment of the annual dues, without entrance fee, become affiliated with the American Electrochemical Society as 'junior associates.' They will be printed as such on the roll of the society, will receive the transactions, the monthly bulletin and other notices of the society, may attend meetings, offer papers, take part in the discussions of papers and participate in visiting and social functions; but they do not have the right to hold office, vote for officers, or vote on or discuss business motions brought before the society. The said 'junior associates' may remain as such not over five years after their first enrollment and may become members at any time by being regularly elected by the board of directors and paying the entrance fee."

At the same meeting of the board the committee appointed to draw up the regulations governing the competition for the award of the Pacific Coast Borax Company's prize of $500 reported. This committee consists of Alois von Isakovics, Dr. E. F. Roeber and Dr. Leo Baekeland. Their recommendations are as follows:

The sum of $500 has been paid to the American Electrochemical Society, and deposited in trust, as a research fund, to be awarded as a prize, under the following conditions:

The Pacific Coast Borax Company desires to awaken an interest in research work and experiments which may lead to some improvement in the commercial method of manufacturing ferro-boron, by a direct process from Colemanite.

It is essential that the process should be sufficiently economical and suitable to be applied on a large scale, so that the finished product may be available for commercial purposes. (Commercial ferro-boron, as now made, contains twenty per cent or more of boron, less than three per cent of carbon, and sulphur and phosphorus are practically absent.)

The prize has been deposited with the American Electrochemical Society, with the request that the board of directors award the same for the best practical solution of the problem, under reasonable conditions, to be decided upon by the board of directors.

In accordance with the above request, competitors for the prize are notified that they must comply with the following conditions:

1. The treatise on the subject must be in typewritten form and accompanied by a sample produced by the process described in same.

2. The competition for the prize is open to any one and is not restricted to members of this society. The treatise on the subject must be enclosed in a plain, sealed envelope, not bearing the author's name, but identified by a pseudonym. The outside of the envelope containing the paper must be labeled with the pseudonym and with it should be sent another plain, sealed envelope, also labeled with the same pseudonym, which should contain inside the envelope the name and address of the competitor. Both these envelopes should be sent to Professor Morris Loeb, 273 Madison avenue, New York city.

3. All papers competing for the prize must be in the hands of Professor Loeb before October 1, 1909. Professor Loeb shall retain the small sealed envelope containing the address of the competitor and forward the large envelope containing the treatise, as well as the sample of the product, both merely labeled with the pseudonym, under cover, to the secretary of the American Electrochemical Society, to be submitted to the board of directors who will award the prize. In this manner, as the treatise must be typewritten, the board can act with entire impartiality and the paper shall be judged on its own merits so that the author's standing can have no influence whatever on the decision. The competitors for the prize forfeit none of their property rights in the process submitted.

4. As soon as the board of directors has agreed upon the best treatise, it will request from Professor Loeb the address of the author thereof, who will then be required to demonstrate his process before the prize will be finally awarded.

5. The Pacific Coast Borax Company, 100 William street, New York city, has offered to supply any one who desires to compete for the prize seriously with all the crude Colemanite that the parties making the experiment may require, provided that the request for this Colemanite be accompanied by a letter signed by one member of the board of directors of the American Electrochemical Society, endorsing the application for the material. This condition is merely made so as to furnish the material only to those who may have the proper qualifications to experiment intelligently and with some chance of success.

For the convenience of competitors who may desire to consult some of the published literature on the subject, a brief bibliography is herewith attached:

H. Moissan and G. Charpy, Sur l'acier au bore, Comptes Rendus, 1895, vol. cxx, p. 130.

M. L. Guillet, Les aciers au bore, Revue de Metallurgie, August, 1907, vol. iv, pp. 784 to 796 (translated in abstract in "Electrochemical and Metallurgical Industry," 1907, vol. v, p. 421).

A bibliography on boron and borides in general may be found in O. P. Watts, "An Investigation of the Borides and Silicides," Bulletin University of Wisconsin, No. 145 (Engineering Series, vol. iii, No. 3, 1906).

As previously announced the fourteenth general meeting of the society will be held in New York, October 31, at the Chemists' Club, 108 West Fifty-fifth street. The invitation of President Acheson to hold the fifteenth annual meeting at Niagara Falls, Ontario, May 6, 7, 8, 1909, was accepted. Headquarters will be at the Clifton House.

Commission Opposed to Central Express Company.

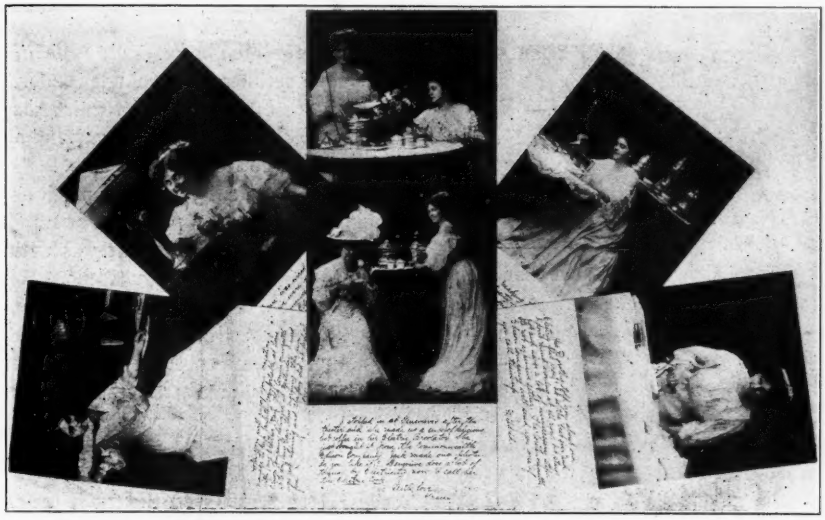
In denying the application of the Interurban Express Company, Syracuse, N. Y., for permission to exercise rights as an express company on certain railroads in and near Syracuse, the Public Service Commission, Second District, lays down the rule that an operating railway or trolley company should not be permitted to divest itself in favor of another corporation of the obligation to perform any of the public services for which it is incorporated unless it can show clearly that public necessity so demands or public convenience can be better served thereby.

The company in question was organized as an express company to do an express business from and to any points in the United States or otherwise by means of electric cars and vehicles, horses, wagons, boats or other means of transportation. The application to the commission was made particularly in connection with the interurban and electric roads controlled by the so-called Bebe Syndicate, namely, the Auburn & Syracuse Electric Railroad Company, the Rochester, Syracuse & Eastern Electric Railroad Company, the Syracuse & South Bay Electric Railroad Company, the Syracuse, Lake Shore & Northern Railroad Company and the Auburn & Northern Electric Railroad Company.

Under the Public Service Commission's law the company can not do business without the consent of the commission. The opinion written by Commissioner Osborne among other things says that the advantages claimed by the service applied for can be easily secured by the trolley companies themselves without the formation of a central express company. He urges against the granting of the application the duplication of companies whereby the public would pay directly to the express company for carrying the package and would also pay indirectly to the railroad company for the use of its tracks in carrying the same package, and the cost to the public is certainly increased by the addition of the extra company.

Some Interesting Advertising Literature from Central Stations.

The Commonwealth Edison Company, Chicago, Ill., has long been famous for the attractive quality of its advertising literature. Dana H. Howard, manager of the advertising department of this company, has introduced some of the most novel ideas which have come to our notice, and the department is one of the most successful in the field. The accompanying illustrations show some of the newest ideas which Mr. Howard has evolved. The series of postal cards showing the various uses of electrical devices, such as toasting irons, chafing dishes, desk lamps, flat-irons, electric fans and coffee percolators, is very handsome and has attracted a great deal of favorable comment. These cards are all photographic reproductions of the highest grade of postal-card souvenir. Another card which the company is making good use of is the assignment card, an illustration of which is shown herewith. This series includes references to closet lighting, the nursery milk-warmer, the electric corn-popper, the electric chafing dish, and the electric waffle iron. The card is printed in brown and red.



A Beautiful Series of Postal Cards from the Commonwealth Edison Company, Chicago, Ill.

The company has recently published a vest-pocket catalogue of electrical devices for use in the home. This illustrates and describes the electric chafing dish, the electric fan, electric curling-iron heaters, electric flat-irons, the electric coffee percolator, the electric toaster, and gives several recipes for use with the electric chafing dish. Still another illustration is a reproduction of a large-sized lithograph which the company is displaying in department stores, drug stores, stationers, and in all public places.

The Denver Gas and Electric Company is keeping up its good publicity work, one of its most recent ideas being the distribution of a fine series of postal cards in connection with the Democratic National Convention. The accompanying illustration shows the mammoth electric sign which was used on this occasion, and which has been reproduced and commented upon in the daily papers throughout the entire West. This electric sign was easily the hit of the decorative features of the convention, and impressed the visitors with the ingenuity and availability of the electric sign as a means of attracting attention.

The Commonwealth Edison Company has its mains in this vicinity and is prepared to furnish you with
Electricity for
Lighting, Heating and Power Purposes
at unusually reasonable rates.
The Electric current, which supplies the most sanitary light, is used also now-a-days for heating, cooking and small power purposes in the home. There are Electric Fans, Flat Irons, Chafing Dishes, Coffee Percolators, Heating Pads, Water Heaters, Curling Iron Heaters, Toasters, all operated by electricity at small expense.
Our representative will call upon you if you will mail this card, properly filled out. You are not obligated thereby.
Name
Address
Most convenient time to call

One of a Series of Assignment Postal Cards Used by the Commonwealth Edison Company.

The Denver Bryan Welcome.

An Attractive Lithograph in Bright Colors Used by the Commonwealth Edison Company, Chicago, Ill.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

Absorption of X-Rays.

Probably all elements when subjected to a suitable primary beam become sources of homogeneous Roentgen radiation which is characteristic of the element emitting it. These radiations have been studied by C. G. Barkla and C. A. Sadler, who here give some of their conclusions. When a very absorbable primary radiation is incident on a given element, the homogeneous radiation characteristic of that element is not emitted in appreciable intensity. As the penetrating power of the primary radiation is increased, the absorption decreases only up to a certain point. When the penetrating power becomes greater than that of the radiation characteristic of the absorbing element the absorption of the primary radiation begins to increase and a secondary homogeneous radiation begins to be emitted. Then there is a rapid and considerable increase in both the absorption of the primary rays and in the emission of the secondary rays. When the general penetrating power is increased still further, the absorption decreases again in the usual way, and the intensity of radiation decreases at the same rate as the ionization produced by the primary beam in air. Experiments have not been made to determine if all the extra energy absorbed appears as energy of secondary radiation; but from observations of the absorbability of the secondary radiation and of the ionization it produces, it appears probable that a large proportion is re-emitted. The emergent radiation is a mixture of two homogeneous radiations, the proportions of which depend primarily on the coefficients of the absorption of the incident radiation and of the radiation characteristic of the metal in the metal itself, and the coefficient of the transmission of one into the other type of radiation and the thickness of the absorbing plate. The following is given as a more precise statement of the special power of a homogeneous radiation of penetrating the element emitting it than has previously been given: A radiation which is more absorbable, equally absorbable, or only slightly more penetrating to most substances than the radiation characteristic of the element upon which it is incident, is absorbed much less than one of more penetrating type. It also produces little or none of the characteristic secondary radiation which is produced by the more penetrating radiation.—*Abstracted from Nature (London), July 16.*

On Some Methods of Measuring Capacity with Alternating Currents of Complex Wave Forms.

A quick and convenient method of determining capacity is to measure the current flowing when a sinusoidal electromotive force of known value is applied. But if the wave form departs from a pure sine wave, the ordinary method can not be used without certain precautions. In this article, Robert Beattie describes a number of methods of measuring capacity accurately, which are not affected by the form of the electromotive-force wave. The first of these to be described is the use of a "swamping" resistance placed in series with the condenser under test. If this resistance is so large when compared with the reactance of the condenser that the former determines the magnitude of the current flowing, the capacity may then be measured with an accuracy of a few per cent irrespective of the wave form. Without the "swamping" resistance an irregular wave form might introduce an error of from thirty to forty per cent. If there is any doubt of the adequacy of the swamping resistance, a swamping inductance may be used. The resistance of this must be negligible, and when this is the case the reactance is more effective than a swamping resistance. With this method it is not difficult to measure the capacity accurately within one per cent. If a known capacity be available, the unknown may be compared directly with this, and since the irregularities of the electromotive force affect both to a similar degree, no error will be introduced. In the same way the capacity may be measured by connecting the condenser in series with a known inductance. Rowland in 1898 described a number of zero methods of measuring capacity by means of alternating currents, but did not point out that when these zero methods are used the result is independent of the wave form. Deflectional methods may also be employed, if, instead of measuring merely the current and the electromotive force, the power is also measured. To indicate the value of these different methods, the results of a series of experiments on a single condenser with a wave form of very irregular shape are given. With the simple current and electromotive-force measurements the capacity was apparently twice as much as it was known to be. By placing a swamping resistance in series, the result was within two per cent of the known value. With a swamping inductance the discrepancy was within the limits of experimental error, and the same accuracy was obtained when applying the other methods referred to.—*Abstracted from the Electrician (London), July 17.*

Electricity Supply in Sutton (Surrey,) England.

A brief description is given here of the new electric supply station of the township of Sutton, which lies just outside of the southwestern boundary of the County of London, England. This installation is interesting because of the methods adopted to avoid vibration and noise. The original equipment consisted of alternators direct-connected to reciprocating engines. This gave rise to so much trouble with surrounding householders, through vibration and noise, that the company decided upon the adoption of a steam-turbine plant. This decision was reached after a number of attempts had been made to stop the vibration. One of these consisted in digging a trench thirty feet deep around the edge of the company's land, but this had no appreciable effect. The station stands on solid chalk, as does also private property 100 yards away. The new generating equipment consists of three 500-kilowatt turbines, each coupled to a 250-kilowatt direct-current generator and a 250-kilowatt alternator placed in tandem. Each machine has also an exciter mounted on the end of the shaft. The units run at 3,000 revolutions per minute, and supply fifty-cycle, single-phase current at 2,200 volts alternating, and direct current at 550 volts. The units are mounted on a ferro-concrete pad eighteen inches thick, which in turn is supported on fourteen groups of rubber pads on the Prache system, each group consisting of seven pads carried on a circular cast-iron tray mounted on a concrete pillar which forms the fixed founda-

tion. This arrangement is said to be entirely satisfactory in damping down the vibration. Another interesting feature of this plant is the use of a Raworth cutout on the switchboard. This is necessary since a part of the direct-current output is used for electric railway purposes where the Raworth regenerative system of operation has been adopted. The cutout is a reverse-current breaker which disconnects the feeder when the incoming regenerated current from the car exceeds that sent out by the station.—*Abstracted from the Electrical Review (London), July 17.*

The Economical Aspects of Wood Preservation for Structural Purposes.

There has been more or less discussion during recent years on the value of the various processes of treating wood with a view to preventing decay. However, a good deal of uncertainty still exists respecting the economical value of such treatment. In this article C. P. Winslow discusses the subject from this point of view. After pointing out the enormous consumption of timber of all sorts, which exceeds three times the annual growth of the forests in this country, he emphasizes the necessity for reducing the annual cut of wood, and says that the only apparent method of relieving the situation is some treatment of the timber which will protect it against decay. To be successful, the process employed must reduce the cost of the timber to the consumer; but in determining this cost the effect of the reduction in price due to the reduced cut, as well as the cost of replacement, must be considered. Such a system should render durable the soft woods which to-day can not be used where exposed to the weather. It has already been shown that the life of timber may be doubled by the use of cheap preservatives; and by using a more expensive treatment, the life can be still further prolonged. In applying such treatment on a large scale the additional cost will seldom exceed the present price of the lumber. This cost may then be set off against the cost of replacing the material and the increase in price which would have taken place had the drain on the forests continued at its present increasing rate. During the past five years the cost of mining timbers in the West has increased forty to fifty per cent, and a corresponding increase may be expected during the next five years, if no relief be secured. To show more specifically what the effect of treatment might be, consider the railway tie situation. During 1906 about 103,000,000 ties were purchased, these being in general oak, cedar and chestnut. Oak formerly was the most largely used wood, but the cost of oak ties has doubled in the past ten years, so that other woods are now being taken. It has been estimated that on an important western road the average cost of untreated hemlock is about seventy-five cents a tie; the cost of a satisfactory treatment with zinc chloride is about twelve cents a tie, raising the cost of the treated tie to eighty-seven cents. If the untreated tie last five years, and interest be allowed at four per cent, the annual charge on this tie would be 16.8 cents. If the treated tie last but a single year longer, the annual charge is lowered to 16.6 cents, while if it last ten years, the annual charge is 10.7 cents. By the substitution of creosote for zinc chloride, with some increase in the cost of treatment, the ties can be counted upon to resist decay for twenty years. It is of no use, however, to give a tie a length of life as long as this, if its mechanical life is but ten years; so that screw spikes and tie plates would become advisable when the more expensive processes of treatment are used. To take another instance, during the year 1906, nearly 3,600,000 poles were cut for telephone, telegraph and electric power lines. The average value of these poles at the point of purchase was $2.65. As these poles come from a limited section of the country, the cost of transportation often equals the initial cost at the point of purchase. All these poles must be renewed within fifteen years; and as the supply of cedar and chestnut, the woods principally used for poles, is becoming exhausted, a substitute must be found which may be treated so as to give it a satisfactory life. A thirty-five-foot loblolly pine may be purchased, hauled and set for five dollars; so that allowing interest at five per cent, the annual charge becomes $1.15. A pole of this sort may be given a satisfactory butt treatment with creosote for one dollar and unless set in very unfavorable conditions will have a life of twenty years. The annual charge is thus reduced to forty-eight cents, a yearly saving of sixty-seven cents a pole. These two instances demonstrate the economical value of a preservative treatment when properly applied. Several other examples are given, applying to other lines of construction, all of which show that whenever timbers are to be placed for permanent use under conditions favorable to decay, or where a subsequent replacement would entail heavy charges, a thorough preservative treatment of the best quality is recommended. Frequently when a company is using large quantities of timber the establishment of a treating plant will soon repay the cost of investment.—*Abstracted from the Engineering Magazine (New York), August.*

High-Speed Electric Elevators.

During a discussion on traction elevators before the Western Society of Engineers, John W. Mabbs described the high-speed electric elevators now in service in the Chicago Board of Trade Building. The car of the elevator is suspended from one end of the system of ropes; the latter are then carried over the overhead sheaves, and down around an idler to which is attached the counterweight, and then up to a fixed point. The counterweight is a self-supporting and self-propelled device; it is worm-geared, and climbs up and down two vertical columns by means of four pinions which engage four racks mounted on the columns. As the motor ascends the racks, the car descends at twice the speed, covering the entire travel while the counterweight travels but half the height of the building. To prevent over-running in either direction, automatic stops are provided at both ends of the travel of the counterweight, and there are also mechanical oil buffers which are sufficient to take care of the machine should the controller and all the automatic stops fail. The speed of the elevator ranges from 540 to 600 feet a minute, though it is said a higher speed may safely be given if desired. These elevators may be reversed at full speed without perceptible pause and without a particular shock or jar. The cars stop more quickly and less disagreeably than hydraulic elevators. One of these elevators has been in constant operation in the Chicago Board of Trade Building for five and a half years, and has been out of service but a single day. Two years ago four more similar elevators were installed in the same building and have been in operation since then, and but one machine has been out of service, and that for only a single day. The repairs on the elevators have averaged less than $85 each a year, while the energy consumed has been 3.54 kilowatt-hours per car mile.—*Abstracted from Journal of the Western Society of Engineers (Chicago), June.*

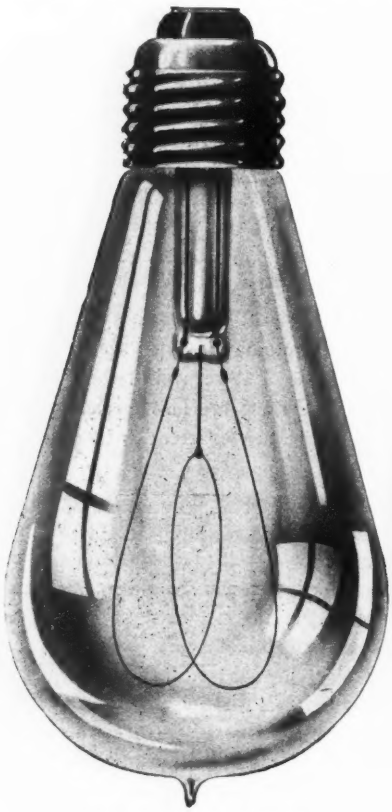
INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

New Gem and Tungsten Lamps.

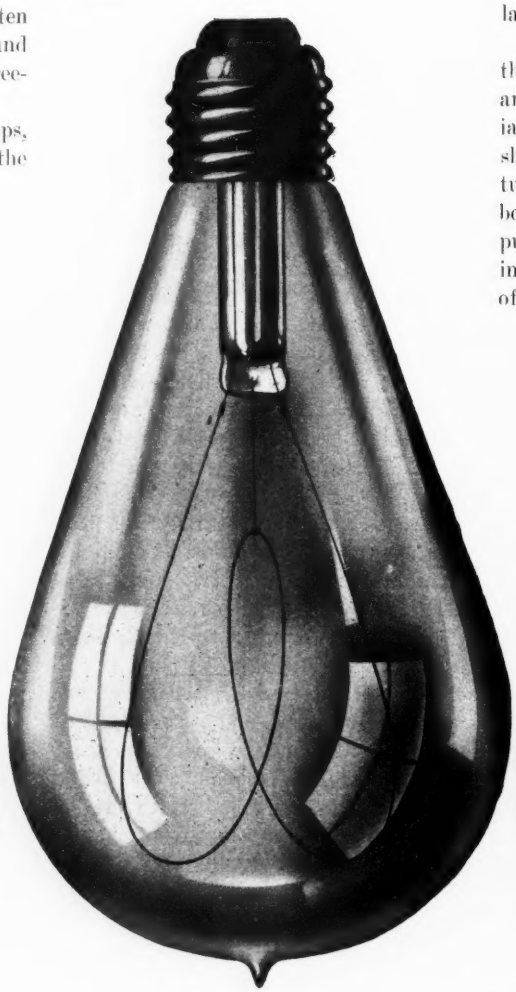
The members of the National Electric Lamp Association are placing upon the market four new types of lamps. Two of these are Gem lamps with oval filaments, all Gem lamps of the same voltages having been heretofore made with two-loop filaments only. Two of these are tungsten Meridian type lamps in the regular round Meridian type bulbs of three and three-quarters-inch and five-inch diameters.

The existing Gem filament type lamps, ninety to 130 volts, are all made in the double-loop type. A great deal of difficulty has been experienced in properly metallizing filaments of other forms and types. This difficulty has been now overcome so far as the oval type is concerned and this type of filament is being employed in the two new Gem lamps now ready for the market.



GEM FORTY-WATT LAMP.

Gem lamps, voltages 90-130, have been made heretofore in the 50, 100, 125, 187 and 250-watt sizes. The two new types are supplementary to the above, are of forty and eighty-watt sizes and are designed for the same voltages, namely, 90-130, as the present Gem lamps. The mean horizontal candle-power of the forty-watt size, therefore, is sixteen candles and of the eighty-watt, thirty-two candles, at two and one-half watts per mean horizontal candle.



GEM EIGHTY-WATT LAMP.

These two lamps are made in bulbs which are standard in the carbon-filament sizes for sixteen and thirty-two-candle-power, respectively. The sixteen-candle-power bulb (the SS 19 bulb) is standard in the Gem fifty-watt size now on the market; consequently, the Gem forty-watt lamp in this size of bulb is similar to the Gem fifty-watt lamp, although dissimilar as above noted, in the type of filament.

The Gem eighty-watt lamp, designed to operate at thirty-two candles at 2.5 watts per candle is made in the bulb (the SS 24 bulb) which is standard in the thirty-two-candle-power carbon type of lamp, and, therefore, so far as cursory inspection goes, this lamp is exactly similar in appearance to the thirty-two-candle-power carbon lamp which it is expected it will largely displace.

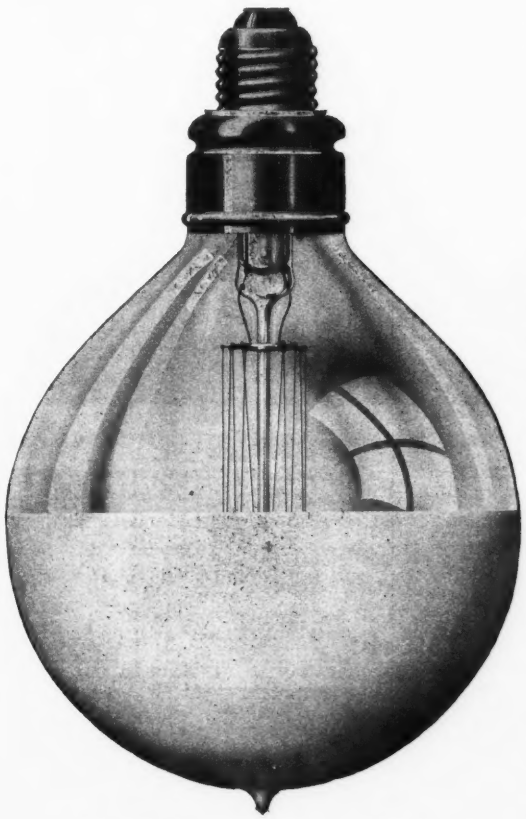
Illustrations of these two lamps using the ordinary small standard Edison base are shown herewith. The tungsten Meridian lamps, illustrations of which are also shown herewith, differ from the other tungsten-filament lamps which the members of the National Association have been putting out for these voltages (100-125) in that five filaments are employed instead of four, and in the size and shape of the bulb. Every change in size and shape of the bulb involves new problems in exhaustion and means new apparatus and equipment.

FORTY-WATT MERIDIAN TUNGSTEN LAMP.

The development of the tungsten lamp in this country has been extremely rapid and the production facilities of the association members have been taxed to supply the demand. The supply, however, of the larger-bulb lamps is now equal to the demand and, inasmuch as these two lamps require somewhat similar manufac-

turing facilities to the large-bulb lamps, the attention of the staff, which has been devoted to the developing of the larger-bulb tungsten lamps (100-125 watt) has recently been given to equipping for the tungsten Meridian type lamps which are expected to displace the present Meridian type lamps almost universally.

The Meridian type lamps were first placed upon the market with carbon filaments and gave sixteen and thirty-two candles mean horizontal (unfrosted) at sixty and 120 watts, respectively.



Sixty-Watt Meridian Tungsten Lamp.

With the advent of the Gem filament these same lamps were put upon the market at fifty and 100 watts with an increase in candles (mean hemispherical candle-power, unfrosted) to twenty and forty candles, respectively. It will be noted that these new tungsten lamps give higher candles than any of the preceding types, in the same size of bulb, namely, thirty-two and forty-eight, respectively (mean hemispherical candle-power, clear bulb).

These lamps operate at the same filament temperature that has been adopted for the other types of tungsten lamps, namely, 1.25 watts per candle horizontally.

These tungsten Meridian lamps can be operated at any angle and are designed to give the proper distribution of light with the present Meridian or prismo type reflectors and involve no additional fittings (in the way of sockets, shade-holders, etc., or reflectors), and are made in all voltages from 100 to 125 exactly as are other tungsten-filament lamps.

Data book sheets covering these lamps in detail are in the hands of all members of the National Electric Lamp Association and any further detailed information as to standard package quantities, deliveries, prices, etc., can be furnished by the member companies upon request.

The same life values of the approximate sizes are named for these new lamps.

Sales of Small Curtis Turbines.

The increasing use of small Curtis steam turbines is strikingly shown by an inspection of a partial list of turbines under 500-kilowatt capacity which, up to the present time, have been installed by the General Electric Company or are under construction.

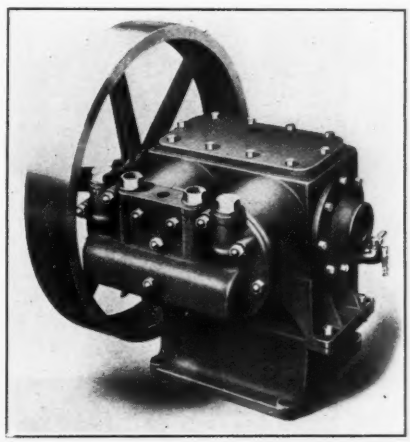
Of the 576 odd turbines listed, representing a total capacity of about 37,000 kilowatts, seven per cent are for the export trade. The remainder are intended for domestic service in central stations, marine work, laboratories of educational institutions, power and lighting plants for hotels and office buildings, laundries, mines, printing establishments and in every branch of manufacturing. It is interesting to note the widely different industries in which small Curtis steam turbines are used. Among the list are woodworking plants, foundries, iron and steel mills, distilleries, chemical plants, ice plants, textile mills, breweries, tanneries, flour mills, shoe factories, paper mills, machine shops, textile mills, and ammunition manufacturing plants.

Turbines for train lighting are finding a ready market and it is interesting to note that the leading railroads are using this method of train illumination. The latest application of moderate size Curtis turbines is for driving fire pumps, in which capacity they have been very satisfactory. On board ship, where a compact generating unit is required, small turbine lighting sets are also rapidly coming into favor.

New Air-Brake Type of Air-Compressor for Industrial Service.

The adaptation of the standard types of air-compressors used with air-brake equipments to many industries requiring compressed air has been decidedly successful. The demand for them has broadened to such an extent that the Westinghouse Traction Brake Company has found it necessary to provide a line of belt-driven compressors similar to their well-known motor-driven compressor for cases where the only power available is from shafting or where it is not expedient to use either steam or electric motive power.

These compressors, designated as the type F-B belt-driven air-compressors, are made in four different sizes, *viz.*, F-1-B, F-2-B, F-3-B and F-4-B, having fifteen, twenty-six, forty-four and one-half and



Air-Brake Type of Air-Compressor.

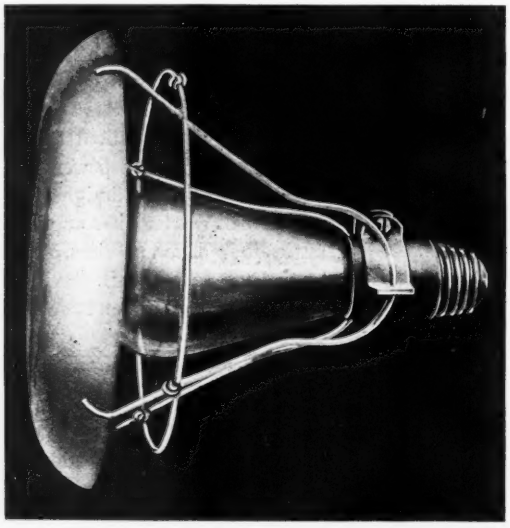
fifty-four and one-half cubic feet of free air per minute capacity, respectively, at the standard speeds, 220 revolutions per minute for the F-1-B and F-2-B, and 200 revolutions per minute for the F-3-B and F-4-B compressors. The horse-power required to operate the compressor in the four different sizes, at 100 pounds pressure, is three, five, nine and eleven respectively.

They will operate successfully against pressures up to 200 pounds per square inch, and may be had with or without water-jacketed air cylinders as occasion requires.

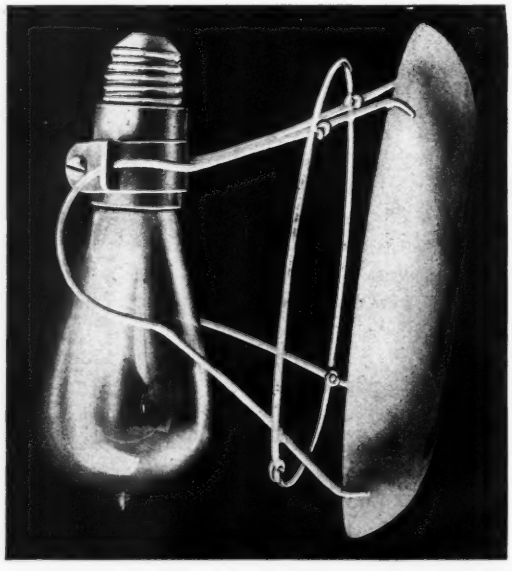
The F-B compressor is most compact in design, being similar in all respects to the motor-driven compressor, except that the motor is replaced by a belt wheel, keyed on the crank-shaft of the compressor. It is of the duplex, horizontal, single-acting type, portable, applicable to any industrial service, and maintained at small cost.

The Phelps Adjustable Sign.

The accompanying illustrations show an adjustable sign which has been developed by the Phelps Manufacturing Company, 54 State street, Detroit, Mich. In designing this sign the aim has been to produce a unique electric sign at a low price. This form of sign is adaptable to every kind of electric fixture, and can be turned to read in any desired direction. As a show-window sign the lamp, while illuminating the sign, also throws light on the goods in the window. It is easy to handle, economical to ship by mail or express, and fits any socket at any angle. The sign is lettered in translucent colors with either raised or surface work.



PHELPS ADJUSTABLE SIGN PLACED AT END OF LAMP BULB.



PHELPS ADJUSTABLE SIGN PLACED PARALLEL WITH LAMP BULB.

Motor-Driven Refrigerating Machinery.

A comparatively new, yet rapidly growing, use to which electric motor drive is applicable is that of the refrigerating outfit. Only those closely connected with the trade realize the varied and extensive use to which these machines are put.

Two years ago motor-driven refrigerating machines were common in residences, dairies, saloons, drug stores, butcher shops, packing houses and hotels. To this list have been added ice cream and candy factories, florists, fish and game markets, hospitals, cold-storage warehouses, tanneries and general office buildings.

The tendency on the part of the public to demand pure, cool drinking water points to the general use of refrigerating machines for cooling drinking water in all public institutions, such as libraries, schools, etc., and in general office buildings. In connection with refrigeration, motor-driven carbonating machines might be suggested. These machines may be installed in drug and confectionery stores for supplying the aerated water used in soda fountains.

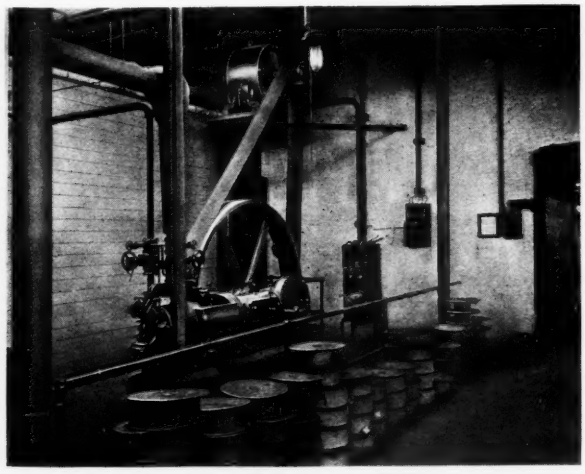


FIG. 1.—FORTY-HORSE-POWER MOTOR DRIVING COMPRESSOR.

Electric motor drive, besides being in most cases the most economical in operation, is a clean, reliable source of power, and one available at all times. Motor drive, because of its simplicity, can also be readily understood and operated by even the ordinary mechanic. The subject of cleanliness is one not to be overlooked, especially by those engaged in the manufacture of ice cream and candy.

The cost of electric energy is about one-half that of ice at the present scale of

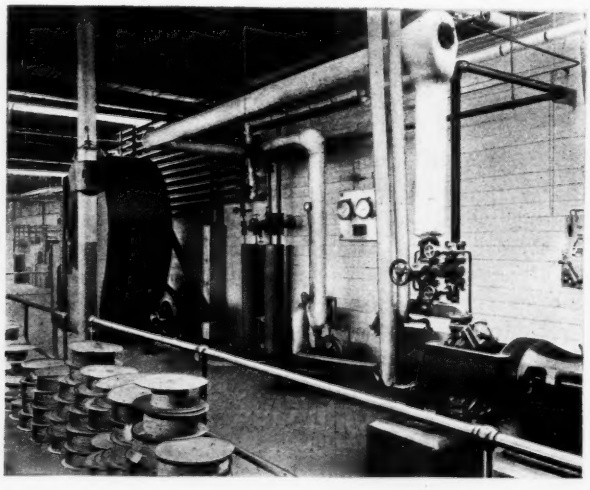


FIG. 2.—MOTOR-DRIVEN BLOWER AND CENTRIFUGAL PUMPS.

prices, and the owner of a refrigeration plant has no fear of an ice famine. In most cases it is not necessary to operate the plant continuously. This, and the fact that the minimum capacity is required at night and in cool weather, makes it possible for the user of electric energy to keep his machines off the peak load of the station, and thus obtain the lowest kilowatt-hour rate.

The installations in common use vary in size from one-quarter-ton residence outfit to the fifty-ton packing-house plant. In most cases the small machines are belt-connected to motors, and the large machines use silent roller chain drive.

Fig. 1 and Fig. 2 illustrate the equipment of the Western Electric Company's motor-driven refrigerating plant at their Hawthorne works. This equipment, used to cool the rooms of the cable plant during the summer months, acts both as a cooling and ventilating system. The brine circulation system is used exclusively, all expansion coils being located in the brine tanks. The apparatus consists of an ammonia compressor, a cooler containing the brine tanks, a blower and a brine pump.

The compressor, shown in Fig. 1, is driven by a forty-horse-power, direct-current motor, mounted near the ceiling. The compressor, operating in connection with ammonia pipes in the brine tanks, reduces the temperature of the brine, which in turn cools the air in the cooler. These brine tanks are open, and the brine in them is kept in circulation by means of a centrifugal brine pump, driven by an eight-horse-power motor. When the air within the cooler is at the desired temperature, the large exhaust fan, shown in Fig. 2, is started. This fan drives the air through the cooler, where the temperature is lowered, and out into a distributing system. The blower is belt-connected to a twenty-horse-power, direct-current motor. This plant was designed by S. W. Calhoun, consulting engineer, of Chicago, and has a capacity of fifteen tons. The motors used to drive the compressor, brine-circulating pump and fan are all 220-volt, direct-current machines, built by the Western Electric Company.

New Sectional-Gang Conduit Boxes.

The Chicago Fuse Wire and Manufacturing Company, 170 South Clinton street, Chicago, is placing on the market a new conduit box, No. 160, embodying the sectional-gang idea employed in its well-known type "AA" and "BB" boxes for flexible conduit. A box for any number of gang switches can be built up from a two-gang box shown in Fig. 1, by loosening the screws and inserting spacers, the box and cover part of the spacer being formed of one piece, the only detachable part on top being the small end-cover plates which may be removed without taking out a screw, permitting ready access to the bushings of end conduits, also allowing examination of wires without disturbing switches.

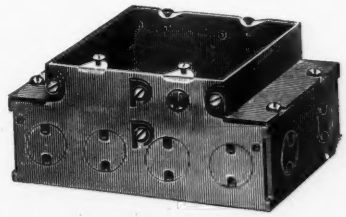


FIG. 1.—TWO-GANG BOX.

Fig. 2 shows a three-gang box with spacer in place, the hook-eye construction enabling these boxes to be assembled without removing a single screw, forming a perfectly tight box, meeting in every detail the requirements of underwriters, as well as filling a long-felt want of electrical contractors for a sectional-gang conduit box in which there is ample room for conduit connections, wire joints, etc. This

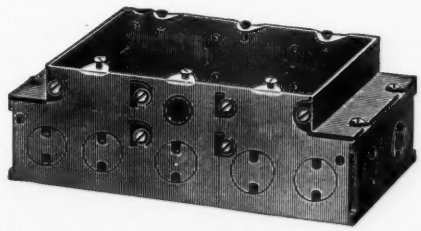


FIG. 2.—THREE-GANG BOX.

box makes an ideal junction box when equipped with a flat cover, and is particularly suitable as a cutout box, being designed to accommodate the single and double-pole main line blocks and also several single and double-branch cutouts manufactured by this company.

Each spacer is provided with two knock-out plugs for one-half-inch or three-quarters-inch conduit as specified, while each box portion is equipped with six such openings.

The spacings between switch-lug centres are standard so that all gang-switch plates fit perfectly. The advantage of this construction over the single-piece gang boxes must appeal at once to every user of conduit boxes, as it enables him to meet any demand for gang boxes with only a stock of two-gang boxes and spacers.

Glue Cookers.

The accompanying illustration shows a ten-gallon glue cooker shipped to the J. B. Lyon Company, Albany, N. Y., by the Westinghouse Electric and Manufacturing Company. The Westinghouse company builds a line of these cookers ranging from five to twenty-five gallons in capacity, and they are used by the manufacturers of printing press rollers, bookbinders and large cabinet work shops where it is necessary to melt and keep in working condition large quantities of glue or other compositions for replenishing the smaller glue pots used on the bench. These glue cookers are arranged with two heats, a high heat for melting down raw stock, and a low heat for holding the stock at a working consistency.

ELECTRICALLY HEATED GLUE COOKER.

A New Seamless Trolley Pole.

A new seamless trolley pole is being put on the market by the R. D. Nuttall Company, Pittsburg, Pa. It is made of cold-drawn seamless tubing of the highest grade to be obtained.

Great strength is insured by a reinforcement at the bottom and a gradual taper at the top. The reinforcement is sixteen and one-half inches long and made of the same material as the pole proper. It is inserted cold and with such care as to fit that it practically becomes a part of the pole.

The taper begins three feet from the top and reduces the diameter from one and one-half inches at this point to one inch at the end. This gives to the pole great strength and rigidity.

The pole is made in all lengths up to eighteen feet and combines rigidity with light weight. The average weight of the twelve-foot poles is twenty-two pounds.

The Crocker-Wheeler Company and Ampere.

The island now known as Manhattan has had at various times forty-six different names applied to it, ranging from Manetto and Manath to Munhaddons. The town of Ampere, N. J., is often called out of its name in spite of the natural simplicity of the word. Ampere is named after the celebrated French scientist, whose name is also used throughout the world as the unit of electrical current. Letters addressed to Ampere (which, by the way, is the only place in existence so named) have borne the following words: Amfere, Amphion, Amperre, Ampore, Ampee, Amperr, Ampre, Ampire, Ampier, Ampiere, Ampsere, Ampero, Amperc, Ampen, Ambere, Amerer, Ampeal, Ampeare, Amphere, Amphen, Ampicre, Auspere, Ampeere, Ampers, Amperel, Ampeu, Monpere, Onviere.

The town was named Ampere by the Crocker-Wheeler Company, manufacturer of electrical machinery. The name of the company has been variously written as follows: Corcker-Wheeler Company, Crocker-Wheller Company, Crooker-Wheeler Company, Crocker Water Motor Company, Croaker & Wheeler, Crocker-Wheeling Company, Crocker-Wheelwe Electric Company, Crocker-Wheel Company, Crocker-Wheeler Electric Company, Booker-Wheeler Company, Brocker-Wheeler Company, Crokett-Wheeler Company, Chrocker-Wheeler Company, Clocker-Wheeler, Cricker-Wheeler Company, Rocker-Wheeler Company, Croker & Wilson Gas Engine Company, Croker & Wheeler Company, Crosier Wheeler Electric Company, Crocker-Wheeles Company, Croker Willer Dynamo Company, Croper & Weeler Company, Croker-Wheeler Company, Croquer-Wheeler Company, Crocker-Whaler Motor Company, Crocker-Wheelef Company, Wicker & Wheeler, Vrocker Wheeler Company, Wheeler & Crocke, Crocker-Williams Company.

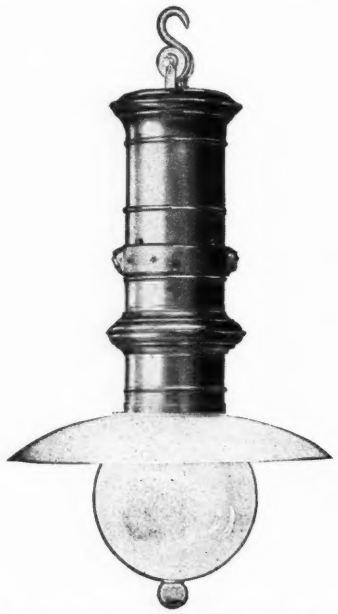
Electrical Supplies for the Navy Department.

The Bureau of Supplies and Accounts will open bids in Washington, D. C., on August 18 for the following electrical supplies: 35,000 arc-lamp carbons, 1,000 feet of lamp cord, miscellaneous fuses, miscellaneous electrical supplies, weatherproof wire and rubber-covered wire, for delivery at Norfolk, Va.; 2,500 feet of Circular Loom, miscellaneous electrical supplies, switches and rubber-covered wire, for delivery at Washington, D. C.; two feeder panels for delivery at Boston, Mass.

The "Stavelco" Semi-Enclosed Arc Lamp.

The accompanying illustration shows the new "Stavelco" semi-enclosed arc lamp which has been placed on the market by the Stave Electrical Company, No. 1 Madison avenue, New York city. It is claimed that by allowing a certain amount of the oxygen from the air to burn with the arc, the luminosity of the lamp is added to, and the ultra-violet rays are eliminated. The light emitted by this lamp is almost pure white, and is exceptionally favorable for department stores, printing plants and other industries where colors have to be matched under artificial illumination.

The mechanism of the lamp is decidedly simple and depends upon the clutch-feed



THE "STAVELCO" SEMI-ENCLOSED ARC LAMP.

principle. The matter of trimming the lamp has been carefully worked out, and the carbon guide is split at the lower end so that the carbon-holder is easily accessible for inspection. The life of the electrodes is between twenty-eight and thirty hours, and small-sized carbons are used. The diameter of the carbon is six millimetres, and the crater is thus confined to a small point on the carbon, and there is little tendency for the crater to travel on the outer edge of the carbon, resulting in a greater steadiness of light.

The efficiency of the lamp is stated to be very high. With a current consumption of four amperes, the mean hemispherical candle-power is 800.

The lamps are arranged so that they can burn in multiple on 110 volts or in series on 220 volts. They are made for either direct current or alternating current, and in the latter case for any frequency from forty cycles to 125 cycles.

Wagner Transformers for United States Reclamation Service.

An initial shipment of water-cooled power transformers, forming part of an ultimate equipment of thirty-six transformers, aggregating 10,530 kilowatts, for the United States Reclamation Service in connection with the Salt River, Arizona, irrigation project, has recently been made by the Wagner Electric Manufacturing Company. The specifications for these transformers were issued last July, and the contract was awarded to the Wagner company under severe requirements as to insulation, operating characteristics, etc., and also under rigid stipulations as to prompt delivery. The recent shipment comprises six 350-kilowatt, twenty-five-cycle, 2,300-26,000-volt step-up transformers and nine 235-kilowatt, twenty-five-cycle, 23,100-1,100-volt step-down transformers. The design of the transformers required dealing with certain special conditions at the places of installation, among which were the limited space for handling the transformers in the power-house, and the high temperature of the cooling water due to the hot climate of the desert region. The water is circulated through the cooling coil of each transformer by a Wagner three-phase motor-driven triplex pump.

New Shelby Tube Company Elects Officers.

Permanent organization of the new Shelby Tube Company has been perfected by the election of the following officers and directors:

President, J. C. Fish; vice-president, C. M. Skiles; second vice-president, C. S. Hook; general manager, A. C. Morse; secretary, Howard Seltzer; treasurer, James Brubaker. Directors: J. C. Fish, Charles Hook, G. M. Skiles, A. C. Morse, J. A. Seltzer, Roger Heath, Edwin Mansfield, H. W. Hilderbrandt, T. J. Green, Jonas Feigher, Y. O. Peters, Robert Greer, J. W. Williams, R. P. Bricker and C. S. Moore. The total amount of capital subscribed is $250,000. The company is incorporated for $500,000.

Ground will be broken soon at Shelby, Ohio, to erect the new tube mill. The United States Steel Corporation owned a tube mill at that place, and it was destroyed by fire about six weeks ago.

Current Electrical News

DOMESTIC AND EXPORT.

TO BUILD BIG POWER-HOUSE AT GRAND RAPIDS—At a directors' meeting of the Menominee & Marinette Light and Traction Company it was decided to increase the capital of the company from $450,000 to $1,000,000 for the purpose of building a power-house at Grand Rapids, Mich. Seven thousand horse-power will be developed by this plant, which will be brought to the cities of Menominee and Marinette. The necessary capital has been subscribed.

THE VANDERBILT ELECTRIC LINES—The Mohawk Valley Company, which has been the holding company for the Vanderbilt electric lines in New York, has certified to the secretary of state that it has reduced its capital stock from $20,000,000 to $7,500,000. The paper is signed by W. C. Brown as vice-president of the New York Central & Hudson River Railroad Company, and Horace E. Andrews as manager of the Central Railway syndicate. It is stated that the ascertainable debts and liabilities of the company are $7,104,657, and that the amount of the reduction of the capital stock is to be distributed among the stockholders of the company. The capital stock of the Rochester & Eastern Railway Company, another Vanderbilt road, is increased from $1,500,000 to $15,290,200, the certificate being signed by Horace E. Andrews as president of the Mohawk Valley Company.

NEW COLORADO POWER PLANTS—Plans for th projected $1,000,000 improvements of the Empire Water and Power Company in Cascade Cañon, west of Colorado Springs, have been approved at a deferred annual stockholders' meeting, and work will be begun soon. The stockholders have authorized the issuance of a $1,000,000 mortgage and the delivery of $500,000 of its first mortgage bonds to a New York banking house, making this amount available at once. Three power plants will be built, one at Green Mountain Falls, a second at Cascade and a third at Manitou. The company will generate electricity by water received from its reservoirs on the north slope of Pike's Peak. The directors would not await the outcome of a suit by L. A. Bigger, of Kansas, owning property in the cañon, who seeks an injunction restraining the company from carrying out its plans on the ground that it will depreciate the beauty of the cañon.

NEW NORTH CAROLINA POWER COMPANY FORMED—The Charlotte Power Company has been formed under the laws of the state of New Jersey. Among those interested are W. S. Lee, W. H. Martin, L. C. Harrison and R. B. Arrington, all officials of the Southern Power Company, and in addition to these, it is understood that a number of prominent capitalists from New York are also behind the movement. The Southern Power Company, as a corporation, has a block of stock in it. The capital stock of the company is $300,000 and the charter provides for the construction and operation of gas, electric and lighting systems in and around Charlotte. The main offices of the concern will be located at Charlotte, from which point as a pivot operations will begin. Permanent organization is expected to be formed at an early date with the election of officers and the transaction of other business incidental to launching a project of such proportions.

NEW VIRGINIA ENTERPRISE—One of the biggest concerns organized in Virginia for a long time is that for which application has been made for a charter. It is the Roanoke Traction Company, with a capital stock of from $500,000 to $2,000,000. Roanoke, Lynchburg and Clifton Forge are to be the principal offices of the company, which is to engage in general lighting, heating and furnishing of power for all sorts of enterprises in the cities named. The power for developing this electricity is to be obtained from the James River, at what is known as the "Horseshoe," up above the city of Lynchburg. The water power there is susceptible of easy development and can be cheaply transmitted to the three cities named. At the same time the small towns intervening between the three cities will be able to have electric lights at the minimum of cost. James P. Wood, of Roanoke, is president; R. C. Jackson, vice-president; James C. Martin, secretary-treasurer. A check for $1,000 accompanied the application for the charter.

NEW PUBLICATIONS.

SOME THINGS A MANUFACTURER SHOULD KNOW ABOUT COAL—The Arthur D. Little Laboratory has issued as professional paper No. 3, an article entitled "Some Things a Manufacturer Should Know About Coal," by E. G. Bailey, chief of the coal department. The work of this laboratory is primarily directed toward increasing the efficiency of industrial effort, by aiding manufacturers, public service corporations and individual clients in the economical selection of raw materials, the mechanical control of processes and products, and the study of special problems. This article was originally presented as a paper at the annual meeting of the National Association of Cotton Manufacturers, held at Boston, Mass., April 16 and 17.

LIST OF APPROVED ELECTRICAL SUPPLIES—The Electrocraft Publishing Company, Detroit, Mich., announces that the third edition of the "Electrocraft Illustrated List of Approved Electrical Supplies" will shortly be issued, and that copies will be sent free of charge only to actual buyers of electrical supplies and persons directly influencing buying. The publisher requests immediate applications for copies, to be made on the letter-heads of the applicants and accompanied by ten cents in stamps or silver to pay postage. The new list will be greatly enlarged and improved, and everything electrical which has been approved by the Underwriters' Laboratories will be fully illustrated and described. It will also contain the National Electrical Code, illustrated and explained.

NEW INCORPORATIONS.

LOS ANGELES, CAL.—Needles Light and Power Company. $50,000. Directors: W. B. Palmer, W. W. Perry and M. P. Thyl.

MILLTOWN, WIS.—Milltown Mutual Telephone Company, Milltown. $4,000. Incorporators: John H. Rahr, Mads Bank, Simon R. Tweeten.

LITTLE ROCK, ARK.—The Grant and Dallas County Telephone Company. $25,000. Incorporators: R. E. Harrison, president; M. G. Bell, secretary and treasurer.

BEALLSVILLE, OHIO—The Mellott Ridge Telephone Company, Beallsville. A. N. Varner, C. F. McDougal, L. A. Mellott, Charles Bolon, G. Pittman. Capital $30,000.

GUTHRIE, OKLA.—The Hackleberry Farmers' Telephone Company, McPeek. $5,000. Directors: D. M. Davis, D. E. Glency and J. C. Pierce, of Arnette; S. S. Lawrence, of Reason, and H. M. Connor, of McPeek.

DEPEW, OKLA.—Depew Telephone Company, Depew. $1,000. Directors: M. Pate, John S. Crail, L. N. Cothern, W. F. Malley, W. S. Langfitt, W. J. Green, E. W. Sims, J. M. Bryden, O. S. Coppage and W. A. Stanfield, all of Depew.

EASTON, ME.—Easton Electric Company. For the purpose of making, generating, distributing and supplying electricity in the town of Easton, Aroostook County, Maine. $5,000. Officers: President, C. N. Delaite, Easton; treasurer, C. W. Spear, Easton.

MILWAUKEE, WIS.—The Wayside Telephone Company, Wayside, Brown County; $2,000; incorporators: Joseph Hoffman, Thomas Monahan and John Natzke. The McKinley Telephone Company, McKinley, Polk County; $1,500; incorporators: E. J. Pfluger, Anton Lundmark and Oscar Risberg.

TELEPHONE AND TELEGRAPH.

PENNINGTON, N. J.—A special meeting of the Hopewell Township Committee was held on July 22 to vote on the proposition to grant Pennington Telephone Company, No. 1, the right to set poles along the public highway from T. Romine Voorhees's to Nathaniel F. Woodwards's. The committee decided unanimously in the telephone company's favor.

HILLSDALE, IND.—Residents of Hillsdale and vicinity have organized for the purpose of building an independent telephone line. At a meeting of a number of persons interested in this movement the following officers were elected to carry out the temporary organization: President, D. B. Highfill; secretary, John Fagler; treasurer, Samuel Hamersley.

CHIHUAHUA, MEXICO—Chihuahua has 553 telephones in its telephone system, an increase of fifty per cent in two years and a half. There are ten miles here in the city with 500 miles of wire and cable strung over them. The rural lines connected with the city office cover eighty-five miles. The system belongs to a local company which has invested $60,000. F. Lee Clevenger is manager.

SAN DIEGO, CAL.—Announcement is made that the Home Telephone Company of San Diego has been sold to an eastern syndiciate. It is said that the purchasers paid $120,000 cash for the plant. The deal was conducted through Louis J. Wilde, president of the American National Bank of this city. An important extension to the system projected is the construction of a line to all points in the Imperial Valley.

MOUNT PULASKI, ILL.—According to a certificate filed with the circuit clerk, the Mount Pulaski Independent Telephone Company is no more. The certificate recites that at a meeting held in the Scroggin opera house, July 10, 220 votes out of 265 were represented and of this number 218 voted for a voluntary dissolution and two against it. In accordance with the vote, the company was dissolved, the property disposed of, debt paid and the residue paid those to whom it was due.

MEMPHIS, TENN.—A new long-distance telephone line between Memphis and Jackson, Miss., along the line of the Yazoo & Mississippi Valley Railroad, upon which construction work was stopped by the Cumberland Telegraph and Telephone Company last year, is to be rushed to completion. The line had been completed as far south as Belzoni, Miss., when suspension was ordered on account of hostile litigation instituted against the company and the heavy advance in the cost of construction material.

WHEELING, PA.—The control of the National Telephone Company of Wheeling, one of the largest of the independent companies of the section, has been secured by S. W. Harper and Hon. John A. Howard, of Wheeling, each taking about a third of the stock. The company has been reorganized, Mr. Howard being elected president; Mr. Harper vice-president and treasurer. The company will extend its operations in Washington County, Pa., where it has many franchises, doing much work in Washington borough at this time.

MORELIA, MEXICO—Several business men of Morelia have gotten together to form a stock company to construct a modern underground telephone installation. The company will be called "Compañia de Telefonos Comerciales." A contract has already been entered into with the firm of Siemens & Halske and the corresponding public deed has been drawn up before Notary Public Lic. Francisco Barroso. The stockholders have already made payment of the first assessment according to the by-law of the company, which is capitalized at $80,000.

PEORIA, ILL.—At a recent meeting of the directors of the Farmers' Mutual Telephone Company it was decided to open an office in Tremont, where headquarters will be established. The $20,000 stock of the company has all been subscribed and will be issued at once. The matter of building a new line or buying out an opposition company has been left to a committee and it will get down to business immediately. The proposed line will traverse six of the best townships in the county and has among its stockholders the best farmers of the county.

NASHVILLE, TENN.—The United States Trust Company, of Louisville, Ky., has filed a bill in the Federal Court asking for a receivership for the Home Telephone Company, of Clarksville, Tenn., and Ernest B. Denizen, who has been manager of the company at Clarksville, has been named receiver. The receivership is, in effect, a step in the direction of complete reorganization of the company. The bondholders are seeking to foreclose a mortgage for $140,000 spent in constructing the plant. The company controls exchanges in Montgomery, Houston and Stewart counties.

LAPORTE, IND.—The Merchants' Mutual Telephone Company, of Michigan City, and the Central Union Telephone Company, which for some time past have had under consideration the proposition of a consolidation of the telephone business in Michigan City, make public the fact that the negotiations are about completed and that the Mutual company is soon to absorb the Central Union's exchange and business. The Central Union plant is to be taken over by the Mutual company, the exchanges are to be consolidated and Michigan City will have but one exchange, operated by the Mutual company.

ST. LOUIS, MO.—The Bell Telephone Company of Missouri will erect an addition to its present building at the southeast corner of Beaumont and Locust streets, to cost about $75,000. The addition will have a frontage of fifty-three feet on Locust street, giving the entire structure a frontage of 100 feet on both Locust and Beaumont. The structure will conform in architecture with the present building. It will be of brick and stone and in all details modern. The improvement is planned to meet the growing business of the Beaumont exchange and long-distance station, located in the present building.

ALBUQUERQUE, N. M.—Colonel D. K. B. Sellers, representing important telephone interests, has let a contract to the Nash Electrical Supply Company, of this city, for the immediate construction of forty miles of telephone line from this city to Moriarty, in the Estancia Valley. The contract marks the beginning of a new telephone enterprise which is of first importance to Albuquerque, for not only will it give direct connection with all the towns in the Estancia Valley, but through additional lines now under construction will shortly give direct telephone connections with all the towns along the El Paso & Southwestern Railroad.

ELECTRIC LIGHTING.

BRUNSWICK, ME.—It is understood that the Brunswick Lighting and Power Company is negotiating for the purchase of the real estate and water rights of the Androscoggin Pulp Company.

BRAINERD, MINN.—A $120,000 bond issue has been voted by the city of Brainerd, Minn., for the construction of a new electric light plant and waterworks. The municipal plant does the exclusive electric lighting of Brainerd.

MORRISTOWN, N. J.—It is announced that negotiations have been concluded between the Public Service Corporation and the Morris & Somerset Electric Company whereby the latter leases for a term of 900 years the Public Service Corporation's Morristown electric lighting plant, which also includes franchises in Morris Township.

SILVER CITY, N. M.—The electric light company has been doing some extensive improvement work on its plant. New machinery sufficient to double the capacity of the plant has been installed and work on a new power-house is now in operation. Arrangements have been made to furnish motive power in any quantity to all consumers.

KINGSTON, N. Y.—The Public Service Commission, Second District, has granted the petition of the Kingston Gas and Electric Company for authority to issue $33,000 bonds, not to be sold for less than ninety, the proceeds to be devoted by the Kingston Gas and Electric Company for the refunding of the $32,500 bonds of the Rondout & Kingston Gas Light Company, which are past due.

POCATELLO, IDAHO—James H. Brady, president of the Idaho Consolidated Power Company, of Pocatello, and principal owner of various irrigation and power properties in this section of the state, including the Rexburg Light and Power Company, has closed a deal for the sale of the last-named property to T. M. Hodgins, of Butte, the consideration being $25,000. Mr. Hodgins is owner of the St. Anthony electric light and power plants, and will inaugurate a day and night service.

LEON, IOWA—The Leon Electric Light, Heat and Power Company is to be incorporated, the incorporation papers having already

been filed. The company is to be incorporated with a capital stock of $15,000 and shares at $100 each will be offered for sale. The present owners, who are experienced electric light men, are preparing to use the funds derived from the sale of stock in the reorganized company for the improvement of the plant. H. E. Chase and W. S. Curtis are the owners of the plant.

HARTFORD, WIS.—The city council has purchased the L. Kissel & Sons' electric light plant, exclusive of power plant, the price paid being $5,000. The city voted some weeks ago to install a municipal alternating lighting plant at a cost of $27,000, bonds to be issued for that sum. The Kissel company has been operating an electric plant for a number of years, its franchise expiring this year. As it is not incorporated it was unable to secure an indeterminate franchise. The city will proceed at once to install a power plant on a site recently purchased.

YOUNGSTOWN, OHIO—The Consolidated Gas and Electric Company has secured a new contract for city lighting. The company agrees to light the city all night and every night from now until the end of the year at the present rate. The city is now paying $64 per year for each light on a moonlight schedule. The ordinance provides for an all-night and every-night schedule at $68 per light. As the semiannual appropriation has been made the company will have to furnish the light at the present rate, but has agreed to give an all-night and every-night schedule. The contract is for a term of five years.

FARMINGTON, ME.—Work will be begun shortly on the building of a 200-foot log dam with concrete bottom at Cleveland Rips, in North Anson, on the Carrabasset River, by the Franklin Power Company, chartered in 1903 under the name of the Carratunk Power Company, capitalized at $100,000, to provide Farmington, New Vineyard and ultimately the town of Wilton with electricity for illuminating and manufacturing purposes. The president of the Franklin Power Company is S. O. Tarbox, a well-known Farmington man, and the treasurer is C. O. Sturtevant, of Winthrop. Judge A. L. Fenderson, of Farmington, and Hon. George G. Weeks, of Fairfield, are on the board of directors.

CHEYENNE, WYO.—The Cheyenne Light, Fuel and Power Company has secured a new franchise of the city council, material concessions in rates having been made by the company. The new rate to consumers will be twelve cents per kilowatt-hour. The old rate was twenty cents and was reduced to fifteen cents, the company offering to make a further reduction to fourteen cents. Electricity for power will be five cents per horse-power-hour, all bills being subject to a discount for prompt payment, the minimum bill to be one dollar. The city has also secured a concession in the rate it is paying for street lights. The new franchise includes a contract for ten years; for five years the city is to pay $95 for its street lights each per year and for the remaining five years $90, when a new contract will be made. In order that the company may suffer no reduction of revenue by the reduction in rate, the city agrees to install additional lights to make the monthly payments the same as at present.

SALT LAKE CITY, UTAH—Work on the preliminary surveys for a third power plant for the Utah County Light and Power Company has begun. Professor Richard R. Lyman, of the University of Utah, is in charge of the work. The third power plant, which will be constructed by the company, will be built in Alpine Cañon, about six or eight miles from American Fork. The other two plants of the Utah County Light and Power Company are located in American Fork Cañon. Construction work on the second plant has hardly been completed, but the demand for electrical power has been so great within the last few years that the backers of this company deem it wise to build a third plant. Two sites have been suggested in Alpine Cañon for the third plant, but the matter of selecting the site will be held pending a report from Professor Lyman. The Utah County Light and Power Company furnishes the electrical power for the pumping plant owned by Salt Lake City at the mouth of the Jordan River. Last spring the company secured a contract to supply the Knight smelter at Tintic with electrical power. The power line has only recently been completed. Electrical energy will soon be transmitted to and used at the smelter at Silver City. Besides having these two large contracts, the company supplies all the electric light used in the northern end of Utah County.

ELECTRICAL SECURITIES.

While prices still made slight gains last week, there was apparent a falling off in speculative activity and a diminution in the interest manifested by the outside public in both stocks and bonds. The commission houses reported considerably curtailed business, and it is expected that the present month will witness some slight reaction, although business is expected to continue improving. While it is agreed quite generally that there will be very little improvement in the value of stocks until after the election in the fall, it must be remembered that prices are now at a higher level than they were last August. This is particularly significant of the fact that the present prices will discount considerably gains for the next three or four months. The report of the United States Steel Corporation for the second or June quarter was considered reasonably assuring. Net earnings were slightly larger, but orders on hand showed a small decrease. The improvement in profits reflects the gradual recovery of this important industry.

Dividends have been declared upon the following electrical securities: Electric Properties Company, regular quarterly dividend of 1½ per cent on the preferred stock, payable August 10; Consolidated Gas Company, regular quarterly dividend of 1 per cent, payable September 15 to stock of record August 19. Susquehanna Railway, Light and Power Company, regular semi-annual dividend of 2½ per cent on the preferred stock, payable September 1 to stock of record August 15.

ELECTRICAL SECURITIES FOR THE WEEK ENDED AUGUST 1.

New York:	*Closing.*
Allis-Chalmers common	10½
Allis-Chalmers preferred	33
Brooklyn Rapid Transit	52⅝
Consolidated Gas	138½
General Electric	146
Interborough-Metropolitan common	11½
Interborough-Metropolitan preferred	32½
Kings County Electric	123
Mackay Companies (Postal Telegraph and Cables) common	70
Mackay Companies (Postal Telegraph and Cables) preferred	69⅛
Manhattan Elevated	138
Metropolitan Street Railway	25
New York & New Jersey Telephone	112
Western Union	55¼
Westinghouse Manufacturing Company	78¾

Boston:	*Closing.*
American Telephone and Telegraph	121½
Edison Electric Illuminating	215
Massachusetts Electric	49
New England Telephone	113
Western Telephone and Telegraph preferred	68

Philadelphia:	*Closing.*
Electric Company of America	10
Electric Storage Battery common	39
Electric Storage Battery preferred	39
Philadelphia Electric	9¾
Philadelphia Rapid Transit	15
United Gas Improvement	88

Chicago:	*Closing.*
Chicago Telephone	—
Commonwealth Edison	—
Metropolitan Elevated preferred	47
National Carbon common	69
National Carbon preferred	109

The July average of passengers carried by the Northwestern Elevated was 99,463, an increase of 7,921.

LEGAL NOTE.

METAL SLEEVE DRUM CONTROLLER CASE—Judge Taylor has handed down an opinion in the United States Circuit Court, Northern District of Ohio, Eastern Division, June 24, in the Metal Sleeve Drum Controller case, involving the Lange and Lamme patent No. 518,693, between Westinghouse Electric and Manufacturing Company, complainant, and the Electric Controller and Supply Company, defendant, adjudging the validity of the patent, and concluding that infringement has been discovered.

PERSONAL MENTION.

MR. C. E. F. AHLM has been retained as consulting engineer by the Board of Public Service of Wooster, Ohio, in connection with the proposed municipal electric lighting plant for that city.

MR. CYRUS OSBORNE BAKER, the head of the house of Baker & Company, and known as the platinum king of America, is spending the month of August at the Samoset, Rockland Breakwater, Me.

MR. ARTHUR H. KIMBALL has resigned as superintendent of the Fitchburg Gas and Electric Light Company to accept the position of general manager of the Fall River Electric Lighting Company.

MR. E. J. KULAS, one of the well-known men in the incandescent lamp field, and for years secretary and general manager of the Brilliant Electric Company, of Cleveland, Ohio, has been elected president and general manager of the Tungstolier Company, of Cleveland. The "Tungstolier" is a new departure in electric lighting, consisting of tungsten lamps, Holophane shades, and a special fixture, the whole presenting a practical and harmonious illuminating device which may be utilized for every character of electrical illumination. Mr. Kulas has been very successful in his management of the Brilliant Electric Company, and the same forceful, enterprising and affable characteristics will win for the Tungstolier Company the hearty support of all those requiring lighting devices of this nature.

ELECTRIC RAILWAYS.

MADISON, WIS.—Solomon Perris, attorney for the Interstate Transfer Railroad Company, appeared recently before the railroad commission to ask for a certificate to authorize the road to begin at once the construction of a line from the steel mills near Duluth to Superior.

HAGERSTOWN, MD.—A movement is on foot to construct a trolley line from Hagerstown to Security, a village located about two miles east of Hagerstown. A cement plant costing over $1,000,000 is being erected at Security by the Maryland Portland Cement Company, in which Baltimoreans are interested.

FREMONT, OHIO—The Fremont City Railway, now operating a line between Fremont and Ballville, a village on the south, has made application to the city council for a franchise which will enable the company to extend its lines to the Lake Shore station and to Spiegel Grove, the Hayes home. The council now has the application under advisement.

GRAND JUNCTION, COL.—The city council has granted a twenty-year franchise to the Fruit Belt Power Company for the construction of a street-car line in the city of Grand Junction and from Grand Junction to Fruita. The company is controlled by Colorado Springs and Grand Junction capital. The work on the new road is to begin under the terms of the grant by October 1.

BETHLEHEM, PA.—A new trolley company has been organized at Mauch Chunk and named the Carbon Transit Company. These are the officers and directors: president, Horace Lentz; vice-president, J. C. Dolan; secretary and treasurer, Charles Neast; directors, John C. Dolan, N. D. Cortright, Horace Lentz, Charles Neast, of Mauch Chunk; George K. Moser and Andrew S. Keck, of Allentown.

PENDLETON, ORE.—The city council has granted eastern capitalists a franchise for a street railway system through Pendleton. Work will begin soon. Connection will eventually be made with Columbia River and different Umatilla County points. Montie B. Gwinn represented the company before the council. The capitalists back of the project are the same Pittsburg people who built the line from Bois to Caldwell, Idaho.

UNIONTOWN, PA.—Plans have been made to build an interurban traction line across the Allegheny Mountains from Oakland, Md., to Uniontown, Pa., most of the way near the main line of the Baltimore & Ohio. The company will be known as the Oakland, Sparrow Falls & Uniontown Electric Railway. A charter has been secured in Maryland and one will be secured in Pennsylvania by J. B. Hogg and others, of Uniontown. A double-track survey from Swallow Falls to Oakland is now being made.

MONROE, MICH.—The city council has granted a street-railway franchise to the Toledo, Ottawa Beach & Northern. Provision is made that the company shall forfeit $2,000 for each year the road is not completed and in operation after three years from the date of the franchise. It is the purpose of the company to extend the road to Detroit as soon as possible. Right-of-way agents have been busy for some time, and it is anticipated that everything will be in readiness to proceed with construction next spring.

DENVER, COL.—Articles of incorporation have been filed with the secretary of state by the Burlington Interurban Railway Company for the board of directors. The incorporators are: Ray C. Watson, Frederick O. Olsan, John P. Klug, Frank K. Hatch, Charles I. Moore, Clarence A. Fletcher and Milton L. Chapman. The company is capitalized at $2,500,000 and has its principal offices in Denver. It will operate electric cars in the counties of Denver, Adams, Larimer and Weld and will have terminals at Denver, Fort Collins and Crow Creek in Weld County. The existence of the corporation is fifty years.

LAKE CHARLES, LA.—The Lake Charles Railway and Light Company will take over the franchises and property of the Lake Charles Street Railway Company. The capital stock of the company is fixed at $750,000, divided into shares of $100 each. One-third, or $250,000, shall be preferred stock, bearing a fixed dividend of six per cent, and the rest common stock that shares in the ordinary net profit. The officers and first board of directors follow: Thompson J. Bird, president; J. Alfred Landry, first vice-president; D. J. Landry, second vice-president; A. J. Pujo, third vice-president; Paul O. Moss, treasurer.

JANESVILLE, WIS.—With the incorporation of the Cincinnati Construction Company, which seeks to build an electric interurban railroad between Janesville and Madison, the first step in the construction of the road proposed by an Ohio syndicate was made The incorporators are all Janesville men, being J. M. Bostwick, M. P. Richardson, Archie Reid, P. H. Korst and Richard Valentine. Chief Engineer Joseph Ellis, of Columbus, has finished the first survey of the line from Janesville to Stoughton. It is understood the road will run from Janesville to Madison by way of Edgerton and Stoughton. It will leave Janesville by what is known as the river road and cross the Rock River above Indian Ford. It will be an air line, running to the west of both lakes Kegonsa and Waubesa.

ALLENTOWN, PA.—Mayor Stiles signed the ordinance providing for trolley freight in Allentown. It was passed by councils on July 14, granting the privilege to the Lehigh Valley Transit Company to establish a trolley express service, under certain reasonable restrictions. The cars are to be neat and no freight is to be carried which would be dangerous or offensive. The establishing of a trolley freight system was conceived by President Stevens. The freight house in Allentown is to be located at the old power-house. A special effort will be made to establish a prompt and efficient service to Philadelphia, as well as all other points along the system. From present indications the Philadelphia Milk Exchange will ask the Transit Company to put on refrigerator cars to carry milk. It is proposed to expend $80,000 to start the service.

COLUMBUS, OHIO—At a meeting of the board of directors of the Scioto Valley Traction Company, held recently, the franchise lately granted the company by the city council of Chillicothe was accepted. The company has been making a fight for this franchise ever since the line was completed to Chillicothe some three years ago. The city insisted that the Scioto Valley must enter over the track of the local street railway company, which would have added largely to the mileage operated by the interurban cars. The traction company refused to do this, and as a result has stopped at the corporation line. In the end, however, the company gets the right to lay its own tracks in Chillicothe, and thus will gain an entrance into the heart of the city by the construction of about 2,000 feet of new line. The franchise will mean much more traffic for the company to and from Chillicothe.

INDUSTRIAL ITEMS.

THE NOVELTY INCANDESCENT LAMP COMPANY, Emporium, Pa., is distributing its usual attractive monthly calendar card.

FOX BROTHERS & COMPANY, 126-130 Lafayette street, New York city, are mailing a card calling attention to the merits of the "Polar" flaming arc lamp and the "Radiante" Economy lamps.

THE F. BISSELL COMPANY, Toledo, Ohio, has ready for distribution its calendar card for August. This contains the suggestion that "it is easy to see through" the constant increase in the company's business. The allusion is completed by reference to a piece of clear window glass.

THE DIEHL MANUFACTURING COMPANY, Elizabethport, N. J., is distributing several attractive bulletins, as follows: No. 20, direct-current ceiling fans; No. 21, direct-current Universal fans; No. 151, types "F" and "FC" motors and generators; No. 501, small ventilating fans; No. 502, electric coffee mill.

THE GAS MACHINERY COMPANY, 715-722 Citizen Building, Cleveland, Ohio, announces that the Wile producer heretofore furnished by the Wile Power Gas Company will hereafter be exclusively manufactured by the Gas Machinery Company. J. I. Wile will be sales manager of the Wile producer department.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., has issued bulletin No. 1,107, describing and illustrating standard alternating-current, single-phase switchboard panels. Bulletin No. 1,108 describes and illustrates multiphase, revolving-field, belted generators, form A. Copies of these bulletins will be furnished to those interested upon request.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has prepared a bulletin describing in detail an American Blower engine direct-connected to an Allis-Chalmers "NJ" generator. The conditions met with in small isolated light and power plants in public places, factories, private residences and aboard ship are satisfied in this combination of engine and generator. Copies of this bulletin, No. 1,042-A, will be furnished to those interested upon request.

THE AMERICAN DISTRICT STEAM COMPANY, Lockport, N. Y., on Friday, the 24th ult., suffered the loss by fire of a portion of its Tonawanda plant, where is located its casting mill and foundry. Plans are made for rebuilding the burned portion on an enlarged scale, which is to be of fireproof construction as nearly as may be. The company states that its business for the season will not be delayed on account of the fire. The loss is fully covered by insurance.

DOSSERT & COMPANY, 242 West Forty-first street, New York city, have received orders from Westinghouse, Church, Kerr & Company for 115 special solderless elbow-connectors, 300 and 600-ampere sizes, to connect the station buses through oil switches to the 2,400-volt outgoing lines at the Dutch Point station of the Hartford Light and Power Company, Hartford, Ct. These elbow-connectors can be used to make joints at either right or left angles, and afford a striking illustration of the flexibility of the Dossert devices.

THE MASSACHUSETTS CHEMICAL COMPANY, Boston, Mass., announces that it has entered into a contract with one of the great and conservative insulated-wire manufacturers to supply its entire requirements of cable cloth. The wire and cable company has for many years made its own cable cloth, but has been convinced that by delegating this part of its cable making to the Massachusetts Chemical Company it will get not only a better and more uniform product, but get it at a lower cost per yard than it has been producing it itself.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued two bulletins, 4,601 and 4,602, describing its improved automatic voltage regulators. These are made in various styles for the regulation of one generator or of two or more generators in parallel, either alternating or direct current. Bulletin 4,609 describes a new lamp-testing watt indicator. This instrument is of the portable type and may be carried in the pocket, is intended for use with Edison base lamps, but can be fitted with an adapter for use with either Thomson-Houston or Westinghouse socket lamps, and is designed to give a practical demonstration of the relative watt consumption of various incandescent lamps.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is distributing information on its meter-testing load box for use in testing integrating wattmeters, either in the laboratory or at the point of installation. The boxes are of novel design in that the various resistance units are mounted in enclosed fuse clips and are handled in very much the same manner as the Standard Code fuses. The company is also distributing a new handbook giving considerable data on lighting with tungsten lamps. Tables are given showing the cost of lighting with tungsten lamps as compared with gas mantles and gas arcs, this being worked out at various values from two cents to thirteen cents per kilowatt-hour. This book embodies some twenty-four pages and should prove of interest to central stations in demonstrating to their customers the efficiency of tungsten lamps.

Directory of Electrical and Allied Engineering and Scientific Societies.

(Published in the Second Issue of Each Month.)

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. HOWARD, Cosmos Club, Washington, D. C.

AMERICAN ELECTROTHERAPEUTIC ASSOCIATION. Secretary, Dr. Albert C. Geyser, 352 Willis avenue, New York city.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Dr. J. W. Richards, Bethlehem, Pa. Fall meeting, New York city, October 30-31.

AMERICAN FOUNDRYMEN'S ASSOCIATION. Secretary, Dr. Richard Moldenke, Watchung, N. J.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, Engineering Societies Building, 29 West Thirty-ninth street, New York city.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West 116th street, New York city.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.

AMERICAN ROENTGEN RAY SOCIETY. Secretary, Dr. G. C. Johnson, 514 Bijou Building, Pittsburg, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Professor Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Charles Warren Hunt, 220 West Fifty-seventh street, New York city.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 29 West Thirty-ninth street, New York city.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Park Row Building, New York city. Annual meeting, Atlantic City, N. J., October.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, Engineering Societies Building, 29 West Thirty-ninth street, New York city. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY ACCOUNTANTS' ASSOCIATION. Secretary, Elmer M. White, treasurer Birmingham Railway, Light and Power Company, Birmingham, Ala. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY CLAIM AGENTS' ASSOCIATION. Secretary, B. B. Davis, claim agent Columbus Railway and Light Company, Columbus, Ohio. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY ENGINEERING ASSOCIATION. Secretary, J. W. Corning, electrical engineer Boston Elevated Railway Company, Boston, Mass. Annual convention, Atlantic City, N. J., October 12-16.

AMERICAN STREET AND INTERURBAN RAILWAY MANUFACTURERS' ASSOCIATION. Secretary, George B. Keegan, 2321 Park Row Building, New York city. Annual convention, Atlantic City, N. J., October 12-16.

ARKANSAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Ark.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. W. Freeman, vice-president and general manager Edison Electric Illuminating Company, Brooklyn, N. Y.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington street, Newton, Mass.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Wisconsin Central Railway, Milwaukee, Wis.

CALIFORNIA ELECTRIC RAILWAY ASSOCIATION. Secretary, L. E. W. Pioda, Oak and Broderick streets, San Francisco, Cal.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Canada.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Acton Burrows, 33 Melinda street, Toronto, Ontario.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, W. F. Milholland, secretary and treasurer Indianapolis Traction and Terminal Company, Indianapolis, Ind.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, J. F. Dostal, Denver, Col. Annual convention, Glenwood Springs, Col., September 16-18.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, F. W. Poole, Bridgeport, Ct.

ELECTRIC CLUB OF CLEVELAND. Secretary, George L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water street, Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Charles J. Sutter, 1220 Pine street, St. Louis, Mo.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

ELECTRICAL TRADES ASSOCIATION OF CANADA, LIMITED. Secretary, William R. Stanley, Royal Insurance Building, Montreal, Canada.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall street, New York city. Board of directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION. Secretary, Charles H. B. Chapin, 154 Nassau street, New York city.

ENGINEERS' CLUB OF PHILADELPHIA. Secretary, H. G. Perring, 1317 Spruce street, Philadelphia, Pa.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt street, New York city.

ILLINOIS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. A. Camp, Henry, Ill.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Van Rensselaer Lansingh, Engineering Societies Building, 33 West Thirty-ninth street, New York city. Annual convention, Philadelphia, Pa., October 6-7.

INDEPENDENT TELEPHONE ASSOCIATION OF TEXAS AND LOUISIANA. Secretary, C. A. Shock, Sherman, Tex.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

INDIANA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. S. Norton, Indianapolis, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Annual meeting, Detroit, Mich., August 19-21.

INTERNATIONAL INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. B. Ward, Grand Rapids, Mich.; assistant secretary, J. A. Harney, Monadnock Building, Chicago, Ill.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. N. Keiser, Des Moines, Iowa.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Iowa.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Iowa.

KANSAS GAS, WATER, ELECTRIC LIGHT AND STREET RAILWAY ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, W. G. Turpine, Henderson, Ky.

MAINE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, M. E. Crow, Houlton, Me.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby street, Boston, Mass. Meets second Wednesday of each month, except July and August.

MASTER CAR BUILDERS' ASSOCIATION. Secretary, J. W. Taylor, 390 Old Colony Building, Chicago, Ill.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshal, Port Huron, Mich. Annual meeting, Grand Rapids, Mich., August 18-21.

MICHIGAN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, A. A. Burch, Battle Creek, Mich.

MISSOURI ELECTRIC LIGHT, GAS AND STREET RAILWAY ASSOCIATION. Secretary, Claude L. Clary, Sikeston Electric Light and Power Company, Sikeston, Mo.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, George W. Schweer, Windsor, Mo.

NATIONAL ARM, PIN AND BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee street, Utica, N. Y.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Frederic P. Vose, 1343 Marquette Building, Chicago.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, John F. Gilchrist, Commonwealth Edison Company, Chicago, Ill.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln.

NEBRASKA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. E. Mattison, Lincoln, Neb.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 60 State street, Boston, Mass.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl street, Boston, Mass. Meetings held on fourth Thursday of every month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 29 West Thirty-ninth street, New York city.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. Max Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, R. N. Kimball, Kenosha, Wis.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Annual convention, Put-in-Bay, Ohio, August 25-27.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, O. O. Welsheimer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Ballard, Cleveland, Ohio.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Charles Currie, Akron, Ohio.

OKLAHOMA ELECTRIC LIGHT, RAILWAY AND GAS ASSOCIATION. Secretary, Galen Crow, Guthrie, Okla.

OLD TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York city.

ORDER OF THE REJUVENATED SONS OF JOVE. C. B. Roulet, Mercury, Dallas, Tex.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 135 South Second street, Philadelphia.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings, second Saturday of each month.

RAILWAY SIGNAL ASSOCIATION. Secretary, C. C. Rosenberg, Bethlehem, Pa.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary-Treasurer, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL AND GAS ASSOCIATION. Secretary, J. A. Myler.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, J. G. White & Company, New York, N. Y.

TEXAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Tex.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary Electrical Committee, C. M. Goddard, 55 Kilby street, Boston, Mass.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary-treasurer, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury Electric Light Company, Middlebury, Vt.

VIRGINIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, B. L. Fisher, Rocky Mount, Va.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 382 Ohio street, Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS (Electrical Section). Secretary, J. H. Warder, 1737 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRIC AND INTERURBAN RAILWAY ASSOCIATION. Secretary, Clement C. Smith, president Columbia Construction Company, Milwaukee, Wis.

WISCONSIN INDEPENDENT TELEPHONE ASSOCIATION. Secretary, J. C. Crowley, Jr., Superior, Wis.

DATES AHEAD.

Michigan Electric Association. Annual meeting, Grand Rapids, Mich., August 18-21.

International Association of Municipal Electricians. Annual convention, Detroit, Mich., August 19-21.

Ohio Electric Light Association. Annual convention, Put-in-Bay, Ohio, August 25-27.

Colorado Electric Light, Power and Railway Association, Glenwood Springs, Col., September 16-18.

Old Time Telegraphers' and Historical Association, and Reunion of Military Telegraphers, Niagara Falls, N. Y., September 16-18.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., October 6-7.

American Street and Interurban Railway Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Accountants' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Claim Agents' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Engineering Association. Annual convention, Atlantic City, N. J., October 12-16.

American Street and Interurban Railway Manufacturers' Association. Annual convention, Atlantic City, N. J., October 12-16.

American Electrochemical Society. Fall meeting, New York city, October 30-31.

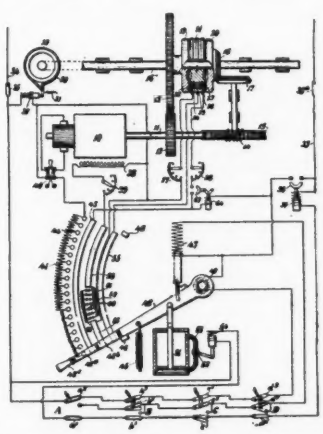
Record of Electrical Patents.

Week of July 28.

894,193. INCANDESCENT LAMP. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. A telephone signal lamp, the ends of the terminals being bent so as partially to enclose the bulb.

894,199. SYSTEM OF CONTROL FOR ELECTRIC MOTORS. Ralph M. Gaston, Morgan Park, Ill. A controller in an auxiliary circuit governs a motor which controls the operating current.

894,201. INSULATOR. Thomas E. Hallett, Chicago, Ill. The insulator is held on a rigid support by a threaded wedge.



894,232.—MOTOR-CONTROLLING SYSTEM.

894,212. TROLLEY GUARD. George S. Keck, Baltimore, Md. Laterally swinging guard arms are provided.

894,214. TELEGRAPHY. Isidor Kitsee, Philadelphia, Pa. A system employing true current reversals and using an inductorium for this purpose.

894,217. ELECTRIC RAILWAY. Mathias A. Lazareff, New York, N. Y. A sectional supply conductor normally connected to the feeder is used, the connecting switches being held open by electromagnets.

894,232. MOTOR-CONTROLLING SYSTEM. Walter J. Richards, Norwood, Ohio, assignor to Allis-Chalmers Company. Gears for driving at different speeds are controlled by magnetic clutches.

894,233. SYSTEM OF MOTOR CONTROL. Walter J. Richards, Norwood, Ohio, assignor to Allis-Chalmers Company. A controller operated from a distance.

894,237. MEANS FOR CHARGING STORAGE BATTERIES. Mary N. Stivers, Jersey City, N. J. A reversing motor is connected in an auxiliary circuit, the former being mechanically connected to the controlling rheostat.

894,257. TELEPHONE APPARATUS. Arthur M. Cobb, Lynn, Mass. A telephone head set supporting two receivers and one transmitter.

894,258. TELEPHONE APPARATUS. Arthur M. Cobb, Lynn, Mass. A head set with a universal joint for the transmitter.

894,305. TURBO-GENERATOR. Alfred H. Wouters, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. An enclosing end bell is provided for supporting the end turns.

894,317. ELECTRODE FOR ELECTROLYTIC OR LIQUID OSCILLATION-DETECTORS FOR WIRELESS TELEGRAPHY. Lee de Forest, New York, N. Y. An electrode of the insulation-covered type for detecting feeble electrical impulses.

894,318. AEROPHORE. Lee de Forest, New York, N. Y., assignor, by mesne arrangements, to De Forest Radio Telephone Company. A device for transmitting electromagnetic waves in predetermined directions.

894,323. ELECTRIC WATER-HEATER. Frank E. Holt, Vancouver, British Columbia, Canada. The water passes through a series of passages, each of which is provided with a heating element.

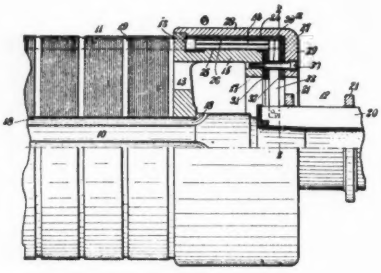
894,326. ELECTRIC SWITCH-REGISTER. John H. Jackson, Watonga, Okla. The track switch automatically closes an electric signal in circuit.

894,329. ELECTRIC GENERATOR OR MOTOR. Carlton L. Kennedy, Braintree, Mass. The pole-pieces are divided and provided with magnetic shunts.

894,333. ELECTRICALLY PROPELLED VEHICLE. Joseph Ledwinka, Philadelphia, Pa., assignor to Russell Thayer, Philadelphia, Pa. A car drawing its power intermittently from an external wire or a storage battery.

894,378. WIRELESS SIGNALING APPARATUS. Lee de Forest, New York, N. Y., assignor to De Forest Radio Telephone Company. The combination of a sending device having a plurality of wave producers and a receiving apparatus consisting of a plurality of complemental wave-responsive devices.

894,435. ELECTROLYTIC APPARATUS FOR PURIFYING LIQUIDS. John T. Harris, New York, N. Y. Water is passed between parallel electrodes formed of metal capable of yielding a colloidal hydroxide.



894,305.—TURBO-GENERATOR.

894,460. TELEPHONE TRANSMITTER. Emile J. Pitrat, Urbana, Ill. A receiver in which the button is kept vertical although the diaphragm may be set at different angles.

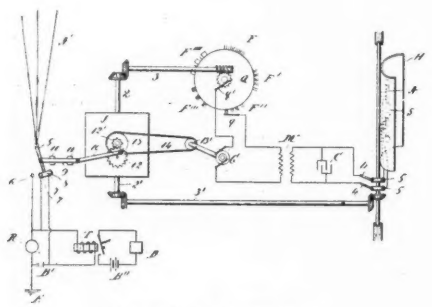
894,468. TANK INDICATOR. Julius E. Smith, North Lansing, Mich. A float for closing a signal circuit when the tank is filled.

894,479. INDUCTION COIL. Amos R. Bliss, Lowell, Mass. The secondary winding is composed of units each consisting of a coil of wire wound on a spool provided with external contact members.

894,482. PLATING MACHINE. Seth C. Catlin, Bloomfield, N. J. A rocking plating tank.

894,518. LIGHTNING ARRESTER. Maurice Milch, Nagy Bittse, Austria-Hungary, assignor to General Electric Company. A plurality of conductors of different material disposed to form a series of air-gaps having greater resistance to the flow of current in one direction than in the other.

894,522. VOLTAGE-REGULATING SYSTEM. Wilbur L. Merrill, Schenectady, N. Y., assignor to General Electric Company. A plurality of counter-electromotive-force generators, each controlled by a separate rheostat, is employed.



894,318.—AEROPHORE.

894,533. DYNAMOELECTRIC MACHINE. Henry G. Reist, Schenectady, N. Y., assignor to General Electric Company. A binding band comprising a metal strip having holes therein and clips acting as fan blades.

894,539. REGULATION FOR MULTIPHASE SYSTEMS. Edward Schildhauer, Washington, D. C., and Albert A. Radtke, Chicago, Ill. A regulating generator is connected in each phase of the main supply circuit, all the auxiliary machines being mounted on one shaft.

894,547. APPARATUS FOR MANUFACTURING NITROUS COMPOUNDS. Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Company. Electric arcs are drawn out in an enclosed air chamber.

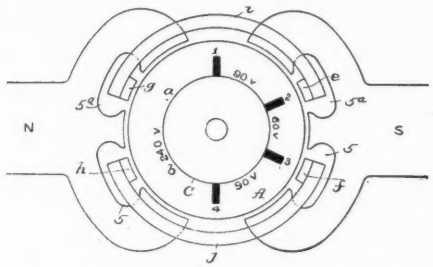
894,563. STARTING RHEOSTAT. William C. Yates and George W. Cravens, Schenectady, N. Y., assignors to General Electric Company. Means are provided for rendering neutral a switch having a tendency to return to the off position.

894,564. RHEOSTAT. William C. Yates, Schenectady, N. Y., assignor to General Electric Company. A reversing rheostat which normally returns to the off position, but which can be held in any position when desired.

894,565. RHEOSTAT. Paul H. Zimmer, Schenectady, N. Y., assignor to General Electric Company. A rheostat with an overload switch.

894,602. SECONDARY OR STORAGE BATTERY. Charles H. Clare, Stratham, N. H. An element having an assemblage of electrodes, active material and plates for supporting the latter, with an opening for receiving and holding an exciting fluid.

894,614. RHEOSTAT. George H. Gorgeloh, Schenectady, N. Y., assignor to General Electric Company. A combined armature and field rheostat.



894,329.—ELECTRIC GENERATOR OR MOTOR.

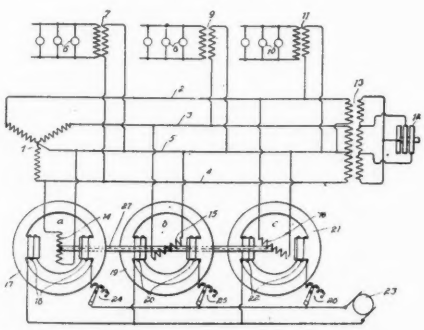
894,620. TRANSFORMER. John J. Frank, Schenectady, N. Y., assignor to General Electric Company. A combined step-up and step-down transformer, the latter having its primary and secondary windings spaced apart.

894,625. INCANDESCENT LAMP. Emery G. Gilson, Schenectady, N. Y., assignor to General Electric Company. The tubular members for supporting the filament are sealed with metal caps.

894,637. TROLLEY CONTACT. Laurence A. Hawkins, Schenectady, N. Y., assignor to General Electric Company. A long, flat, flexible strip of metal.

894,643. CONTACTOR. George H. Hill, Schenectady, N. Y., assignor to General Electric Company. An electromagnetic switch.

894,644. BUS-LINE COUPLING SOCKET. George H. Hill, Schenectady, N. Y., assignor to General Electric Company. The socket member of the coupler is of insulating material having a terminal projecting from the bottom of the cup.



894,539.—REGULATION FOR MULTIPHASE SYSTEMS.

894,645. CONTACTOR. George H. Hill, Schenectady, N. Y., assignor to General Electric Company. An electromagnetic switch operated by a coil and plunger magnet.

894,651. METER. Charles E. Holmes, Lynn, Mass., assignor to General Electric Company. An induction meter.

894,668. SYSTEM OF ELECTRICAL DISTRIBUTION. Osias O. Kruh, Schenectady, N. Y., assignor to General Electric Company. A combination of a mercury rectifier and transformer.

894,714. VARIABLE-VOLTAGE TRANSFORMER. Mercer G. Young, Pittsfield, Mass., assignor to General Electric Company. Means are provided for varying a portion of the primary flux which passes through the secondary winding.

894,766. MEANS FOR OPERATING VAPOR ELECTRIC LAMPS. Ezechiel Weintraub, Schenectady, N. Y., assignor to General Electric Company. A plurality of vapor electric lamps connected in series with one another.